New Junior Encyclopedia

Vol 10

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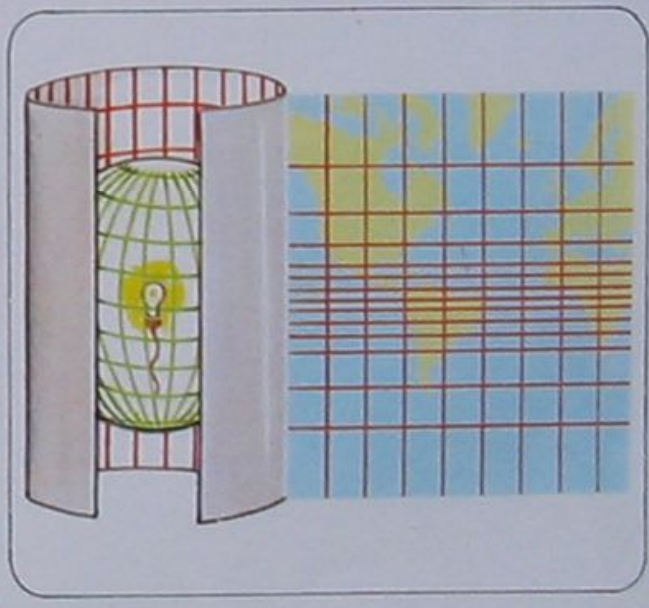
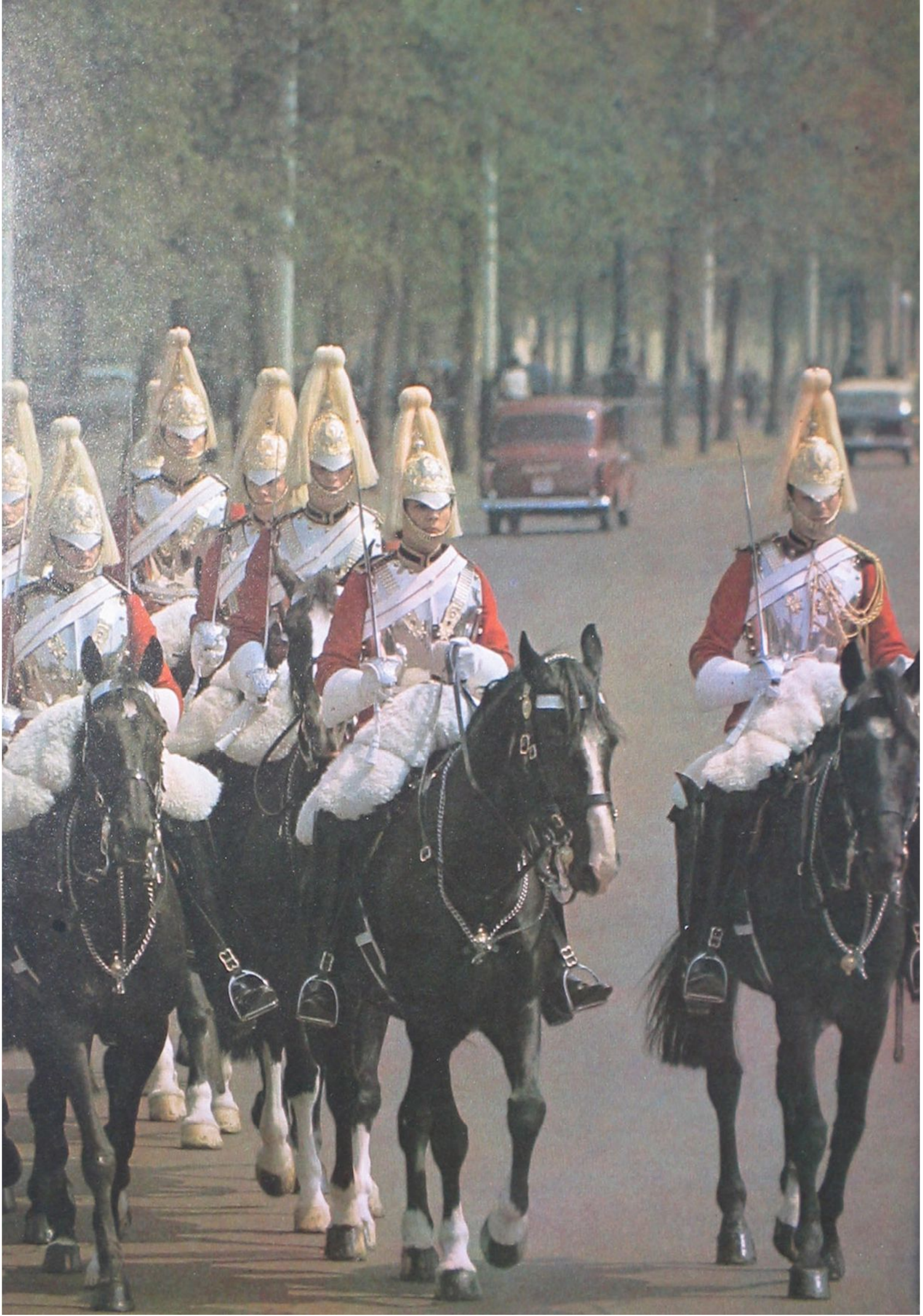
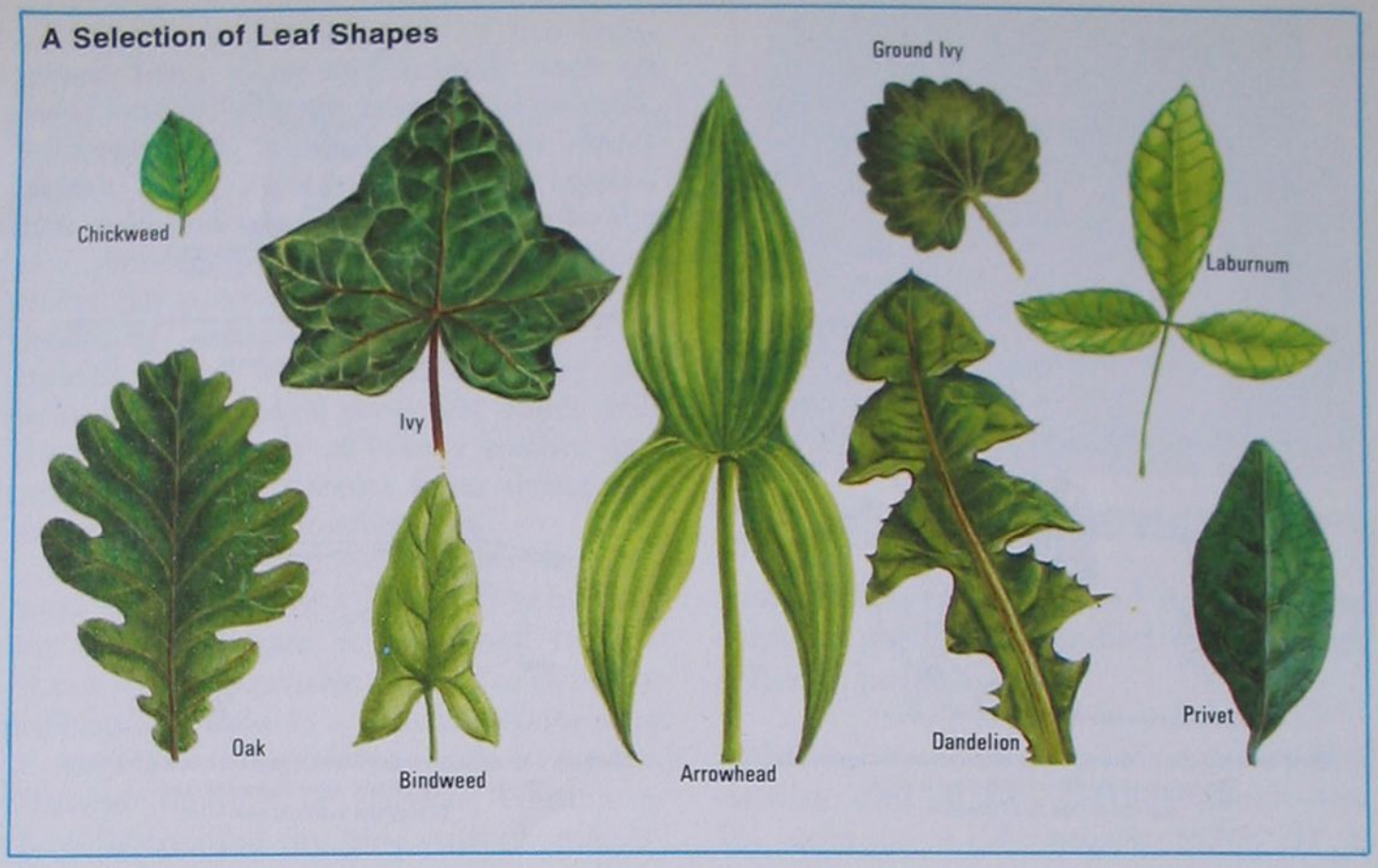


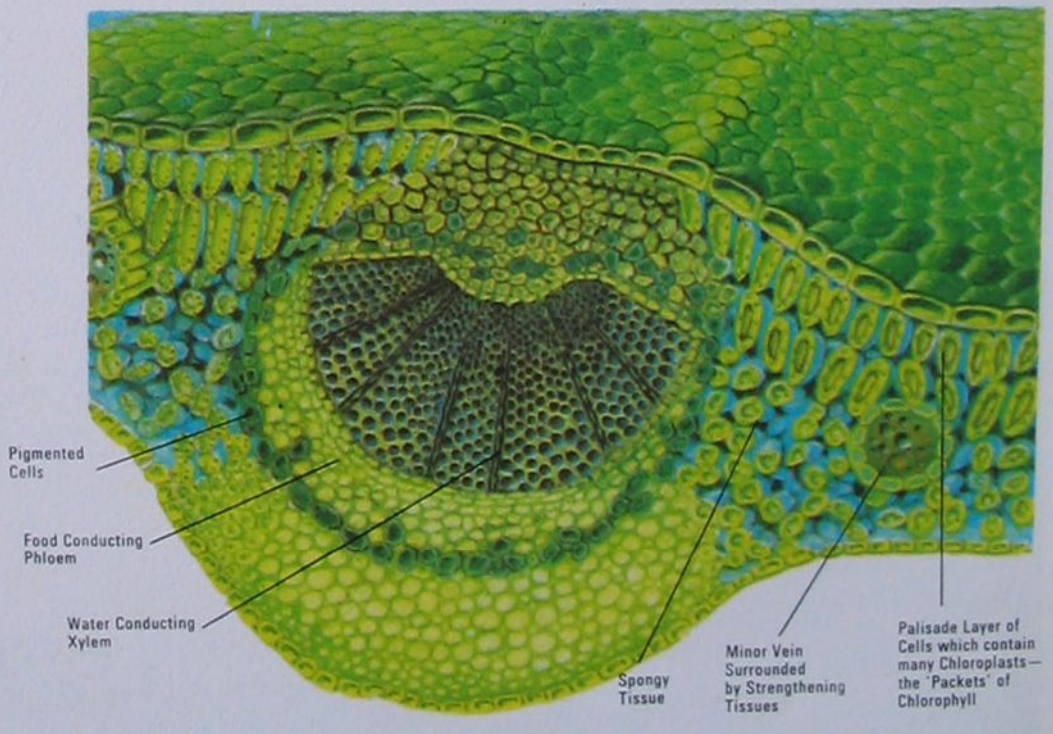


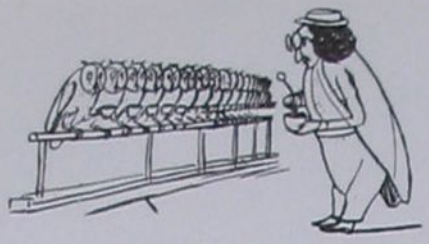


Leaf This is the food-making organ of green plants. A typical leaf consists of a stalk and a blade, although the leaves of some plants grow straight from the main stem. The leaf stalk—more properly called a *petiole*—carries bundles of pipelines which take raw materials into, and manufactured foods out of, the leaf. The blade is thin and flat, presenting a broad surface to the sun.

Leaves are well equipped for their job of food-making. The *palisade layer* of cells in the upper parts of the leaf contain many *chloroplasts*. These are 'packets' of *chlorophyll*, the green pigment which harnesses the light energy of the sun and

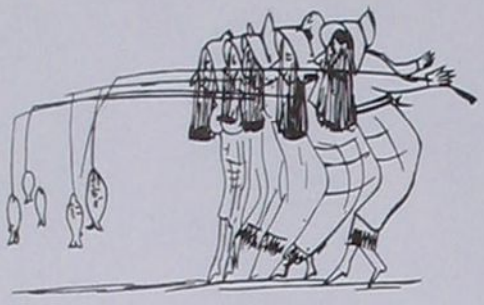
Leaves are really the food factories of plants—the elaborate and delicate structures in which the process of photosynthesis takes place. This is the manufacture of sugars from carbon dioxide and water. The diagram (right) shows the structure of the main veins and lamina of a leaf. The typical leaf consists of a flat blade or *lamina* and a stalk known as the *petiole* which connects it with the stem. Not all leaves have stalks and leaves without them are said to be sessile. In large-leaved plants such as rhubarb the stick of rhubarb is actually a leaf stalk.
Left: Life-guards of the Household Cavalry.


Pigmented Cells
Food Conducting Phloem
Water Conducting Xylem
Spongy Tissue
Minor Vein Surrounded by Strengthening Tissues
Palisade Layer of Cells which contain many Chloroplasts—the 'Packets' of Chlorophyll

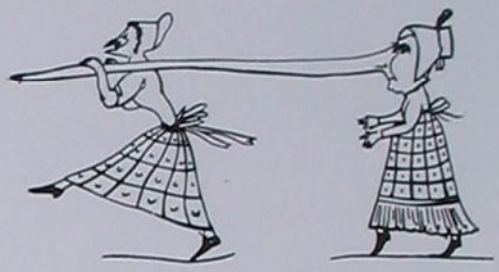


There was an Old Man of Dumbree, who taught little Owls to drink Tea;
For he said, "To eat mice is not proper or nice,"
That amiable Man of Dumbree.

There was an Old Person of Grange, whose manners were scroobious and strange;
He sailed to St. Blubb, in a Waterproof Tub,
That aquatic Old Person of Grange.



There was an Old Man of Marseilles, whose daughters wore bottle-green veils;
They caught several fish, which they put in a dish,
And sent to their Pa at Marseilles.



There was a Young Lady whose nose was so long that it reached to her toes;
So she hired an old lady, whose conduct was steady,
To carry that wonderful nose.

Four limericks by Edward Lear, with illustrations by himself. His inspired absurdity has made his work a favourite with children since it first appeared.

uses it to build up sugars from carbon dioxide and water. (See Photosynthesis.) The carbon dioxide, which is present in air, enters the leaf through pores *(stomata)* which are scattered all over the lower surface of the leaf and appear occasionally on the upper surface. Veins *(xylem)* carry water into the leaf from the stem.

Leaves vary enormously in shape and form from species to species. A *compound* leaf is made of several separate leaflets, like those of ash trees, pea plants and horse-chestnuts. A *simple* leaf is one leaf basically, although it may be deeply lobed or divided.

Leaves are borne on stems in various ways. One of the commonest is the *alternate* arrangement, where the leaves come off the stem singly in a spiral manner. Or leaves may be *opposite*—that is, a pair of leaves develops together and grows out from opposite sides of the stem. *Whorled leaves* are groups of three or more leaves that develop at the same stem level.

Lear, Edward (1812-1888) was an English writer of books of nonsense. He originally made his living by painting coloured pictures of birds and animals, and landscapes. Poor eyesight forced him to give this up. He wrote *The First Book of Nonsense* to amuse the grand-children of the Earl of Derby for whom he was working. It was published in 1846 and was a great success. Edward Lear's books are unique in English literature. They are pure nonsense and are filled with odd animals and unlikely people.

Among Lear's best known characters are the Jumblies, who 'went to sea in a sieve', and the Owl and the Pussy-Cat who were married by a Turkey. These feature in fairly lengthy poems, but Lear also wrote many *limericks* (short humorous poems of five lines).

Leather For thousands of years, men have known how to use animal skins to make leather for shoes, bags and clothing.

Most of the leather that we use today comes from domestic animals such as cows, sheep and pigs. Some wild animals, however, are hunted for their *hides* (skins). These include crocodiles, snakes, mountain goats and even ostriches. In the past, some species were seriously threatened by this practice and were in danger of becoming extinct. Today, many wild animals which have valuable hides are farmed. This makes sure that there will always be a supply of luxury leather and prevents certain species from dying out through too much hunting.

Hides are turned into leather by *tanning*. After cleaning a hide and removing any flesh and hair, it is tanned in one of two ways. *Vegetable* tanning is done by soaking the hide in a solution containing a vegetable ingredient called *tannin*. *Mineral* tanning or *chrome* tanning is done by treating the hide with chemicals. The tanning process preserves the hide so that it will not rot. After it is tanned, the leather is usually dyed a certain colour, then stretched and dried. It may then be polished or buffed with a rough roller to produce *suède*.

Above: A tooled leather saddle, inlaid and painted with elaborate designs.

Lebanon is a country in Asia, at the eastern end of the Mediterranean Sea. Its area is 4,105 square miles. It is

One of the cedars for which Lebanon has been renowned since Biblical times. Few now remain.

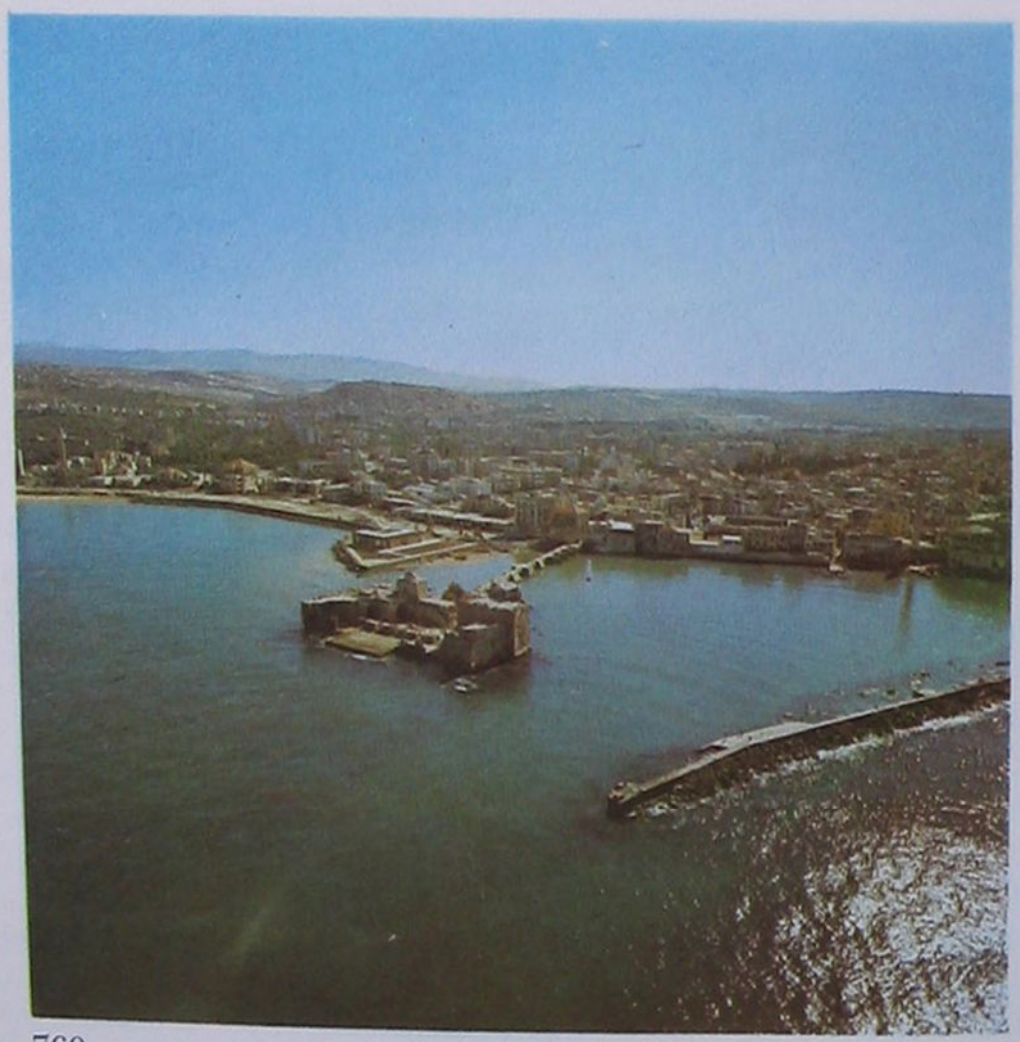
Location map of Lebanon.

mountainous and has a warm, pleasant climate. The beautiful cedar trees that grow there are mentioned in the Bible. Lebanon's 2,645,000 people are mainly Arabs. Some of them are Muslims and some Christians.

Lebanon is one of the most important commercial countries of the Middle East. Beirut, the capital and chief port, is a busy trading and banking city. Lebanon's industries are well developed. Its farmers grow citrus fruits, olives, tobacco and cotton for export. Many tourists visit Lebanon to enjoy the scenery and visit ancient sites.

The Phoenicians, a great seafaring people of ancient times, lived in Lebanon and neighbouring areas. Later, Lebanon was ruled by the Romans and other peoples. It fell to the Ottoman Turks in 1516. At the end of World War I, France was given control of the country. Lebanon became independent in 1946.

Leeds is a city of the West Riding of Yorkshire with a population of just over half a million. Leeds grew rapidly during the Industrial Revolution. Iron and heavy engineering works grew up around local deposits of coal and iron ore. It was, and still is, a centre of the wool industry. The city now supports a wide variety of industries, including tailoring and printing. Leeds has many impressive Victorian buildings and a modern university.



An aerial view of the ancient port of Sidon. It was one of the main trading cities of the Phoenicians and is mentioned several times in the Bible. It was famous for its manufacture of glass and the imperial purple dye, made from shellfish.

The Phoenicians, the ancient inhabitants of the area that is now Lebanon, built a great empire founded on trade. They were skilful and brave sailors and reached as far as Britain where they traded for tin. They colonized Sicily, southern Spain and much of North Africa. The greatest of these colonies was Carthage which dominated the western Mediterranean until it was finally destroyed by Rome in 146 B.C.

Legumes are a large group of plants that includes several important vegetables. The legumes, or pea family, are second only to the plants of the daisy family in numbers of different species. They vary in form from trees and shrubs to herbs. Legumes, or leguminous plants, include the acacia, clover, liquorice, lupin, mimosa and wisteria as well as vegetables such as beans, lentils and peas.

Legumes are very important as food plants. People eat peas, beans, or groundnuts (peanuts) in many parts of the world. Clover, lucerne (alfalfa), and vetch are legumes that are important as animal food.

Legume roots have bulbous swellings called *nodules* that contain bacteria. The bacteria take in nitrogen from the air and change it into forms that the plant can easily absorb. Nitrogen is an essential element for plant growth, but other plants cannot take in nitrogen directly from the soil. Thus rotting leguminous plants are important as fertilizers for soils that lack nitrogen in a usable form. Clovers and other legumes are often grown in crop rotations to add nitrogen to the soil.

Below: Some examples of legumes.

Leicestershire (area 832 square miles) is an inland county in the east midlands of England. Its county town is Leicester, and its population is 771,213.

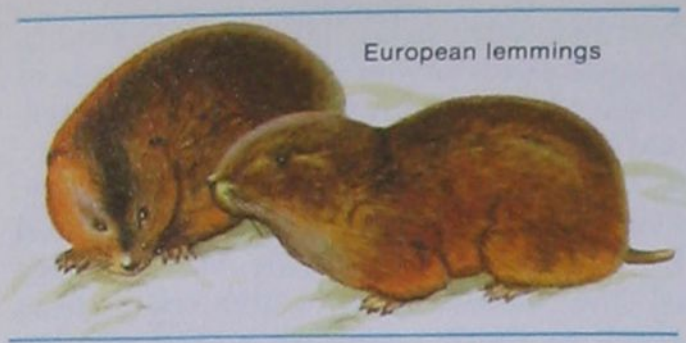
Much of Leicestershire is low-lying. Charnwood Forest in the west is separated from the eastern uplands by the valley of the River Soar, which runs from north to south across the country. Other rivers are the Avon and the Welland. In the east, there are rich cattle pastures. Stilton, the cheese with a world-wide reputation, is made in the Vale of Belvoir. Wheat, oats and barley are grown.

Leicestershire's traditional industry is the manufacture of hosiery, but footwear is also important. The chief towns after Leicester are Loughborough, Hinckley and Coalville.

Leif the Lucky or Leif Ericson was a Viking explorer who lived in the 10th and 11th centuries A.D. He was the son of Eric the Red who founded a Viking colony in Greenland. It is believed that Leif was the first European to reach America. A Norse *saga* (epic poem) tells that, in 999 A.D., Leif was sailing to Greenland from Norway. He missed Greenland and reached the coast of Newfoundland, which he named *Vinland.*

The Vikings established a colony there, the remains of which were discovered in the 1960's. There is evidence that they may have imported wood from America to Greenland. The history of the Vikings in America is not clearly known. Sagas mention voyages to the country over a period of about 12 years.

Leipzig is a major city of East Germany. It has a population of 607,700. The city became important during the Middle Ages as a centre of trade and industry. Yearly industrial fairs were held there. Textiles, steel, chemicals machinery and precision equipment are the main manufactures today. Many of Germany's outstanding musicians and writers were born in Leipzig or lived there.



European lemmings

Lemmings are small, vole-like mammals that live in the cold northern regions of Asia, Europe and North America. They have thick brownish fur and short tails. They grow to a length of about five inches.

The common lemmings of Scandinavia are famous for their periodic emigrations. Every few years, their rate of breeding reaches a peak. The number of lemmings grows so large that there is not enough food, and they begin to spread out in all directions to find somewhere else to live. But vast numbers perish—from starvation, disease, predators (preying animals), or from drowning in rivers or the sea.

Lemurs are a family of small mammals, related to monkeys. They are members of the order of primates. There are 16 different species of lemur. The smallest is the size of a mouse and the biggest grows to about four feet in length. They are found only on the islands of Madagascar and the nearby Comoros. Lemurs have long furry tails and pointed faces with prominent eyes. They use their front feet to hold their food. They inhabit forests and are good climbers. They eat insects, fruit and small reptiles.

Lenin, Vladimir (1870-1924) was a great leader in the Russian revolution. He started the Bolshevik (Communist) Party in Russia, and founded the Soviet state. One of the main ideas of communism is that most property should be owned by the state, on behalf of all the people, and all work should benefit the whole community. Before 1917 Russia was a Capitalist country—that is, property was owned by a few people, and they decided how profits of work would be shared. Lenin fought against this. He became the head of the government in 1917. He is honoured as a great hero by the Russian people.

The turning point in Lenin's life that set him on the road to becoming a revolutionary was the death of his brother Aleksandr in 1887. He was executed for taking part in a plot to assassinate the tsar.

Lenin was born at Simbirsk, in European Russia. It was later renamed Ulyanovsk, after Ulyanov, which was Lenin's real name. His father was the local inspector of education. Lenin worked harder to better the conditions of the poor and to obtain more power for them. The government exiled him in 1897. In Siberia he wrote *Development of Capitalism in Russia*, and in London in 1903 he organized the Bolsheviks as a group. He kept the group together by writing books and letters in England and other countries. He returned to Russia in 1917 after the March revolution had removed the tsar (ruler). He led a second revolution in November to put the Bolsheviks in power.

As leader of the new state, Lenin worked hard to make it powerful. He not only built a new Russia, but his ideas and methods were the foundations of the Communist movement. (See Bolsheviks.)

Left: Vladimir Lenin, the Russian revolutionary who led the Bolsheviks to power in the 1917 revolution in Russia and founded the first communist state. He spent many years in exile in various parts of Europe and was eventually sent back to Russia by the Germans during the First World War in a sealed train. During his years abroad Lenin developed the theories of Karl Marx and Friedrich Engels.

Leningrad is the second largest city in the Soviet Union. It was originally named St. Petersburg after Peter the Great, who founded it as the imperial capital in 1703.

A view of the Ekaterininsky (Great Catherine Palace) near Leningrad. It was first built in 1718 and it was enlarged and added to several times up until 1757. Its Baroque architecture is typical of the artistic revival that took place around Leningrad (then St. Petersburg) in the 1700's.

His architects designed the city on a magnificent scale. It became a glittering cultural and social centre for the rich. When war broke out between Russia and Germany in 1914 its name was changed to Petrograd, to get rid of the German 'burg', and in 1924 the city was renamed after the revolutionary leader Lenin.

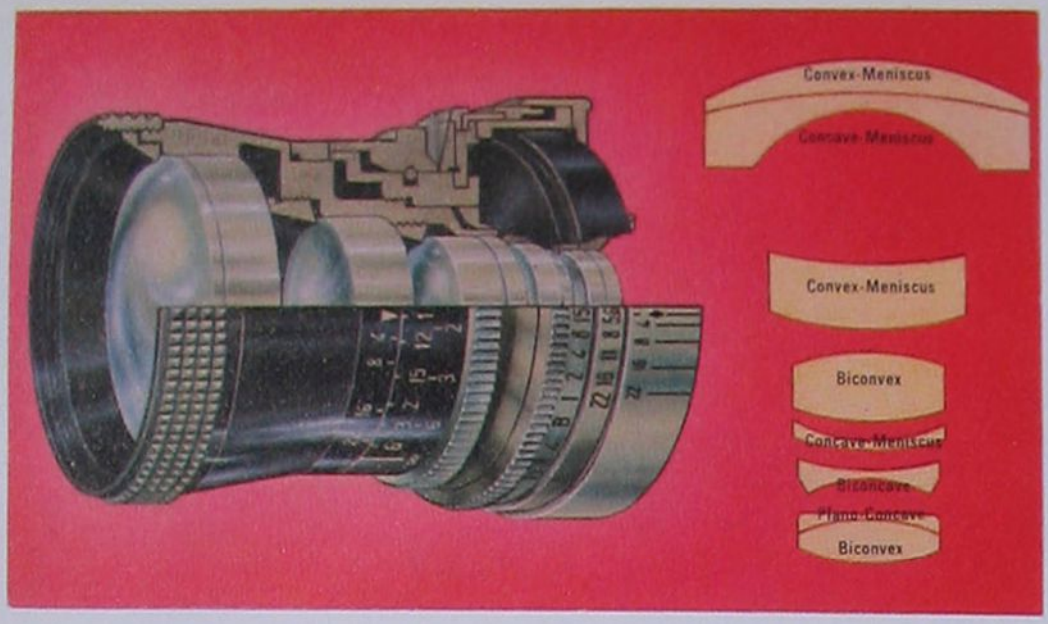
Leningrad is situated on the Baltic Sea, at the mouth of the River Neva. The harbour ices over for part of the year and there is also some flooding. An inland canal carries ships to the River Volga. The city has shipyards, railway works, and factories that produce heavy electrical equipment, metal goods, textiles, chemicals and books. Leningrad is known for its fine schools, libraries and museums. Its population is 3,950,000.

Lens A lens is a specially shaped disc of glass which changes the direction of a ray of light shining through it. This is made possible by *refraction*, an effect in which a ray of light is 'bent' when it passes from one transparent substance (such as air) into another (such as glass).

There are two main types of lenses. *Convex* lenses are thicker in the middle than at the edges. *Concave* lenses are thinner in the middle and thicker at the edges.

Parallel rays of light passing through a convex lens *converge* and meet on the other side of the lens at a point called the *focus*. Rays passing through a concave lens *diverge* or spread out. The focus of a concave lens is an imaginary point where the diverging rays would meet if they could reverse their direction and pass back again through the lens without being refracted.

Rays of light coming from an object and



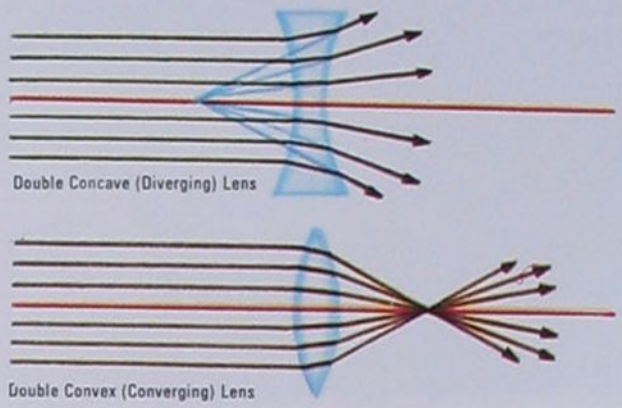
Left: The lens of the camera is made up from several different 'glasses' or components. The shape of each component, the type of glasses used and the separation of the components is skilfully planned to produce an image which is both bright and sharp.

Below: A double concave, or *diverging*, lens spreads out the light rays which pass through it. A double convex, or *converging*, lens brings together the light rays which pass through it so that they meet at the *focus*.

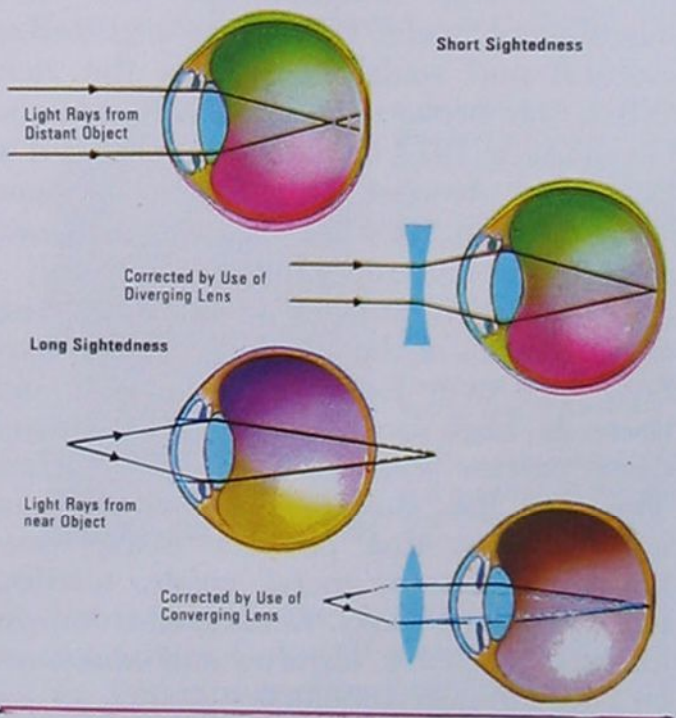
passing through a convex lens can form an *image* on a piece of paper held on the other side of the lens from the object. In a camera one or more convex lenses are used to form an image on a sensitized film. An image cannot be formed like this with a concave lens. Concave lenses are generally used with convex lenses to correct certain distortions in an image; particularly one called *chromatic aberration* in which unequal bending of light causes a 'rainbow' effect in the image.

Leonardo da Vinci (1452-1519) was born near the village of Vinci, about 60 miles from Florence, in Italy. His genius was of the highest order. He has been called the universal man of his time, because his extraordinary gifts were not confined simply to painting. He was also a gifted sculptor, architect, poet, and composer, a pioneer of science, a skilled mathematician and engineer, whose ideas were hundreds of years ahead of his times. He knew more of the workings of the human body, for instance, than the doctors of his day. And he anticipated the idea of flying machines, even to designing a type of helicopter.

Leonardo's early drawings and models so impressed a well-known painter, Andrea del Verrocchio, that he was taken into the artist's own studio, and studied there for several years. He was not only



Below: For objects to be seen clearly, light rays from them must focus on the retina at the back of the eye. In short-sighted persons they focus in front of the retina, in long-sighted persons behind the retina. To such persons some objects seem blurred, but eyeglass lenses can correct their vision, as shown. Light rays are also bent by the cornea at the front of the eye, but for simplicity this is not shown.


Short Sightedness
Light Rays from Distant Object
Corrected by Use of Diverging Lens
Long Sightedness
Light Rays from near Object
Corrected by Use of Converging Lens

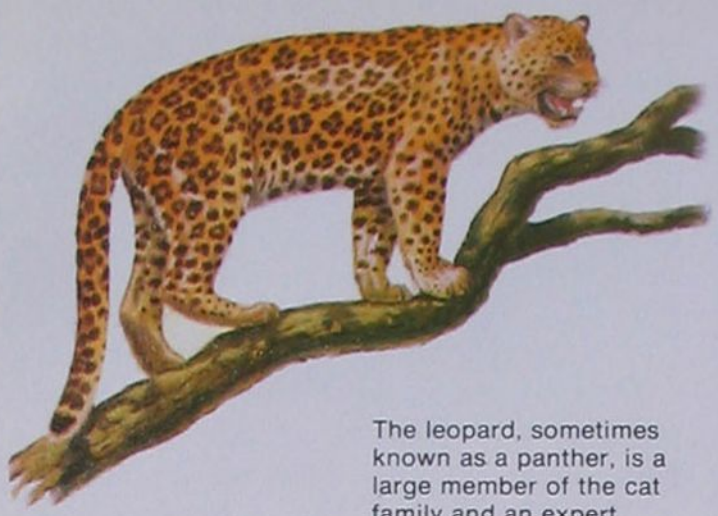
keen to draw accurately everything he saw but wanted to know how everything worked—how human beings saw, what made plants grow, and so on.

In 1478 he began painting *The Virgin of the Rocks*, a masterly work now in the Louvre in Paris. This depicts the Virgin Mary with the child Jesus, and other religious figures against a strange background of caves and rocky arches. A Prince of Milan, Prince Ludovico Sforza, asked Leonardo to come to his court and make a huge statue of his ancestor, Francesco Sforza. The offer was accepted, but the model for this work was destroyed by French invaders who captured Milan before the statue could be cast in bronze. However, while at the court Leonardo carried on with his scientific studies, and made plans for improving the buildings of the city, and its sanitation system. In 1494 he began one of his greatest paintings, *The Last Supper*, on the wall of the church of Santa Maria delle Grazie in Milan. Later he spent some years concentrating chiefly on practical engineering work, and became chief engineer to Cesare Borgia.

On returning to Florence, Leonardo painted the portrait of the wife of a Florentine official, which became known as the *Mona Lisa*. This is probably the most famous painting in the world.

From 1507 to 1513 Leonardo travelled

Cartoon, or sketch, for Leonardo's painting of the Virgin Mary with her mother and the child Jesus. It is in the National Gallery, London.



The leopard, sometimes known as a panther, is a large member of the cat family and an expert tree-climber.

from city to city in Italy pouring forth ideas and works of every kind. The young King Francis I of France invited him to live in a French castle and showered him with honours. He died in 1519.

Leopard The leopard is one of the biggest members of the cat family, reaching a height of 2½ feet and a length of 7½ feet including the tail. Only the lion and tiger are bigger. It is a powerful animal and an expert tree-climber. It hunts and eats almost any wild—or domestic—animal it can find. It lives in most of Africa and Asia from Turkey to China and south to the East Indies.

The leopard is famous for its irregular black spots. They are spread, close together, over most of its body. The rest of the fur is generally light tan in colour. Leopards living in forests are generally darker than those from open country. Some of them are so dark that the black spots can hardly be distinguished. These animals are often called panthers, but they belong to the same species as leopards.

Lesotho is a small, mountainous kingdom in southern Africa. It was formerly a British protectorate called *Basutoland.* The country is completely enclosed by South Africa, and many of its people earn

Location map of Lesotho.

their living working in South African mines. The rest herd cattle, sheep and goats or farm the poor dry land. Maize, millet, wheat and vegetables are the main crops. Farmland in Lesotho belongs to the nation as a whole and is administered by native chiefs.

Lesotho has 1,000,000 people. Almost all are *Basuto,* black Africans who speak a Bantu language. The people live mostly in small villages, in thatched mud houses. The largest town is Maseru, the capital. The Basuto were united by Chief Moshesh in 1818. Trouble with Dutch South Africans led him to seek British protection in 1868. The country became independent in 1966.

Liberia, a republic in Africa, was established as a homeland for freed American Negro slaves by the American Colonization Society. It became an independent country in 1847. Its government is patterned on that of the United States.

Liberia is in the 'bulge' of western Africa. Its area is 43,000 square miles. It has a coastline on the Atlantic Ocean. On its other sides it is bounded by

Location map of Liberia.

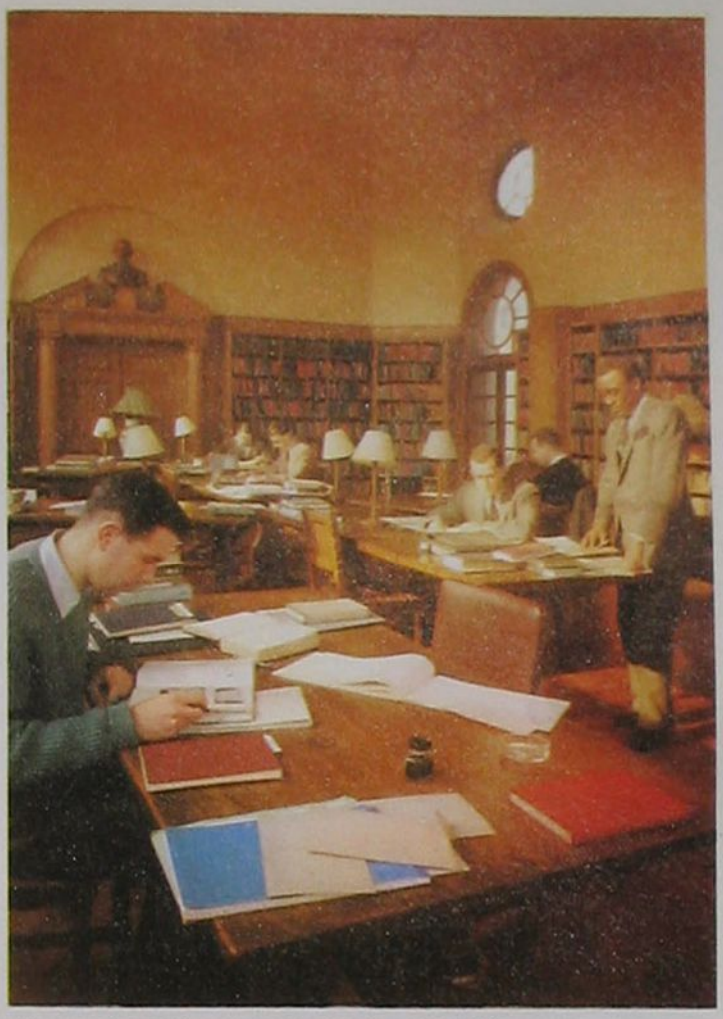
Sierra Leone, Guinea and the Ivory Coast. Its capital, Monrovia, is on the coast. Most of the land is flat. Forests once covered a large area. Many of these were cleared for rubber plantations. The climate is warm. Heavy rains soak the land during certain seasons.

Some of Liberia's 1,200,000 people are the descendants of former American slaves. These people fill most government positions. Other Liberians belong to local tribes. They are mainly farmers. Rice is their main crop. Liberia gains income by exporting iron ore and rubber.

Libraries are places where books are kept. One of the first great libraries was in Alexandria (see Greece, Ancient); the 'books' were papyrus manuscripts. The caliph Harun-al-Rashid, who reigned in Baghdad from A.D. 786 to 809, had half a million 'books'. During the Middle Ages European monks copied ancient writings on parchment, prepared from animal skins. In England many monastic libraries passed into private hands when the monasteries were closed by Henry VIII. As a result of this, and the invention of printing in the 1400's, people began to collect books and manuscripts for their own private libraries. Some of the finest private libraries were the property of the nobility, who had the money to buy books and the leisure time to read them. Until the 1800's the majority of the common people were *illiterate* (unable to read or write).

Some university libraries go back to early times. They have been added to ever since. Certain university libraries, the British Museum, and the National Libraries of Scotland and Wales receive a free copy of every book published in Britain. These are copyright libraries.

The United States Library of Congress is the world's largest. It contains 59 million items that cover an area of six acres and fill 327 miles of shelving. Like the library of the British Museum, it is a statutory library and is entitled by law to receive a copy of every printed item that is published, including newspapers.



Above: A reading room in the London Library where many writers and students engage in research work.

Below: A modern development, a talking book library, where recordings on tape are available.

Perhaps the largest library in the world is the Library of Congress at Washington in the U.S.A. The Leningrad Library in the U.S.S.R. also has a huge collection of books.

There are many kinds of library today. Circulating libraries are run commercially. For a subscription anyone can borrow a book to read. They are usually

libraries of fiction. A reference library is one in which books can be used but not borrowed, and where you can find the answer to any questions. Public lending libraries are paid for out of taxes, for any citizen to use. They contain all kinds of books which can be borrowed.

The running of a large modern library is a complicated business. Librarians undergo up to three years of training before they are qualified. The librarian has three main tasks. First, he must choose and buy books for his library. When doing this he must take into account what his readers want in the way of both fiction and reference books. Modern libraries have many thousands of books in them and it is the librarian's job to arrange them on the shelves in such a way that the reader will be able to find the book that he wants without searching through every book there. Thirdly, the librarian has to prepare *catalogues*. These are lists of authors, titles and subjects arranged in alphabetical order. Each book has a number in the catalogue that shows in which part of the library and on which shelf it may be found.

Libya is a desert country on the Mediterranean coast of Africa. Most of its 1,900,000 people are Arabs. Until 1957, when oil was discovered there, Libya was the poorest of the Arab countries. It has since become one of the richest. The government has used the money from oil to modernize the country.

Libya has an area of 679,360 square miles, although about nine-tenths of the country is taken up by the Sahara Desert. Its people are chiefly farmers. They raise livestock, and grow dates, figs and citrus fruits. The cities of Tripoli and Benghazi, on the Mediterranean Sea, are joint capitals.

Location map of Libya.

Lichens often appear as crusty growths on rocks.

Lichens are tiny plants that commonly grow in exposed and 'unfriendly' places. They are very often seen as greyish or yellow crusty growths on tree-trunks, walls and stones. Lichens are 'pioneer' plants. They are the first to colonize bare rock, breaking down the surface and preparing the way for mosses. In Lapland, a lichen called *reindeer moss* is an important food for reindeer.

Lichens are not one plant but two. They consist of an alga and a fungus living in close association. The fungus forms the major part of the body of a lichen. It absorbs and retains water and breaks down rock or soil to produce minerals. The alga takes carbon dioxide from the air and, together with the water, which is absorbed by the fungus, makes sugars by *photosynthesis* (see Photosynthesis). The fungus takes a share of the food produced. Lichens usually grow very slowly, because they live in places where water and mineral salts are in short supply.

Liechtenstein, a tiny European principality, nestles in the Alps between Switzerland and Austria. It is only 7 miles wide

A castle in Liechtenstein. This small country is still ruled by a hereditary prince.

and less than 18 miles long. About 22,000 people live there. They speak a Swiss dialect of German, and use Swiss money. Switzerland provides customs, postal, diplomatic and other services. The capital of the country is Vaduz.

Liechtenstein has mountain pastures where dairy and meat cattle graze. There is also fertile land for growing fruit, vegetables and cereals. But Liechtenstein's economy is mainly industrial. Factories produce a wide range of products, from handicrafts and processed foods to scientific instruments. The country's postage stamps, because of their value to collectors, are also an important source of income. Many foreign businesses make their headquarters in Vaduz because of the favourable tax laws.

Liechtenstein was established as a princedom within the Holy Roman Empire in 1719, and later became part of the German Confederation. Like Switzerland, it remained neutral in World War II.

Lifesaving techniques of many kinds are used to rescue people in danger of drowning because of shipwrecks, swimming accidents or other mishaps in the water. Speed is essential in attempts at life-saving because once a person's lungs fill with water, there is little time before the heart stops beating. If someone has stopped breathing but is still alive, lifesavers can sometimes restart breathing through *artificial respiration.* This can be done by either kneading the body or by giving the 'kiss of life'. In icy waters, freezing to death is another danger.

A ship in trouble at sea usually radios for help, giving its position. It may be spotted by Coastguard observers or search planes. Specially equipped lifeboats are then sent out. Lifeboats were first designed in the 1780's. They are sturdy, fast and manoeuvrable craft. Many of them are self-righting and can turn themselves the right way up again if they capsize in rough seas. Large ones have room

The Chesil Bank life-boat goes to the assistance of a ship in trouble in rough seas off Portland Bill, England. The life-boat service in Britain is run by the Royal National Life-Boat Institution and is manned by volunteers. The R.N.L.I. is paid for by donations from the public.

Australian lifeguards of the Surf Life-Saving Association march past in a surf carnival held near Sydney. They are carrying the winch equipment that is used to pull swimmers who get into difficulty to safety.

for up to a hundred survivors. Other life-saving equipment includes guns that throw out lines to boats in trouble, and rafts that pack away neatly when not in use, but inflate as soon as they are thrown into the water. In Britain, the Royal National Life-Boat Institution has provided a voluntary rescue service since 1824. Many other countries have similar organizations.

Swimmers off holiday beaches can often get into difficulties. They may get cramp or be swept away by strong currents or, in some countries, even be attacked by sharks. Australia was the first country to introduce lifeguards. Strong swimmers patrol popular beaches and survey the water from look-out towers. The heavy surf can be dangerous and the lifeguards use special surf boats or rescue lines attached to winches to help people from the water. The Surf Life-Saving Association has become a feature of Australian life and its members hold Surf Carnivals and competitions. The Association was founded in 1907 and since then its members have rescued over 130,000 people.

Often when swimmers are in danger there may not be a lifeguard present. Ordinary people on the shore may be able to help by throwing a lifebelt or holding out a pole for the swimmer to grasp. But attempting to rescue a swimmer who is in trouble by swimming with him and trying to hold him up can be very dangerous. A person who fears he is drowning becomes frantic and can easily pull his rescuer under with him. Trained lifesavers know how to approach swimmers in difficulty and carry them safely back.

Lifts move people and goods from one level to another in a building or mine. Modern lifts were developed first in the mid-1800's for carrying freight. They used *hydraulic* (fluid) pressure to raise the load. In 1853, Elisha Otis, an American engineer, designed the first steam-powered passenger lift with safety brakes. In the 20th century, electricity replaced steam power.

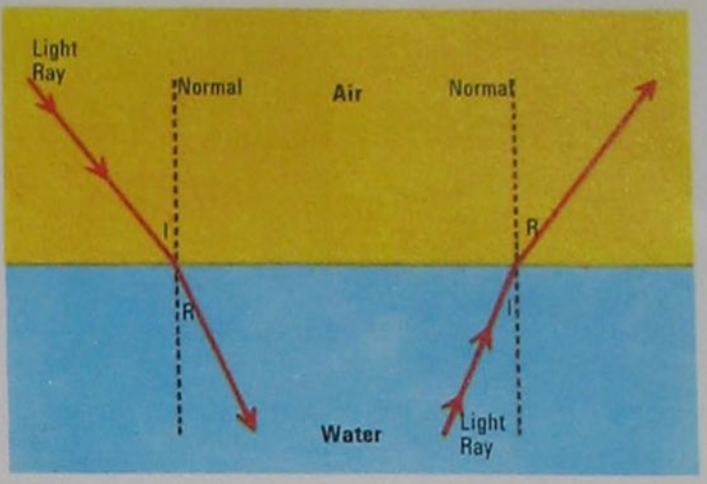
The car of a lift is connected by strong cables that run over a pulley to a heavy counterweight, which balances it. The motor, in effect, lifts only the additional weight of the load. For safety reasons,

a lift will not operate if it is overloaded or if all the doors are not closed. Similarly, the doors at each landing will not open unless the car is there, to prevent people from falling down the shaft. Modern lifts require no operator. They automatically make stops going up and down. In a building where there are a lot of lifts they can be operated by computers.

Light is a form of energy, as heat and sound are. Our eyes are sensitive to light, and we see things because light is reflected from them. If there is no light, we cannot see. Light is produced whenever an object gets extremely hot. For instance, if we heat a poker in a fire, it first gets red hot and gives off a feeble red light. Then it gets yellow, and finally it glows white hot. A white-hot object giving off light is said to be *incandescent*. The wire filament inside an electric lamp becomes incandescent and gives off light when an electric current passes through it. A candle flame contains particles of burning wax which become incandescent and give off light. The Sun is a fiery ball of incandescent gas.

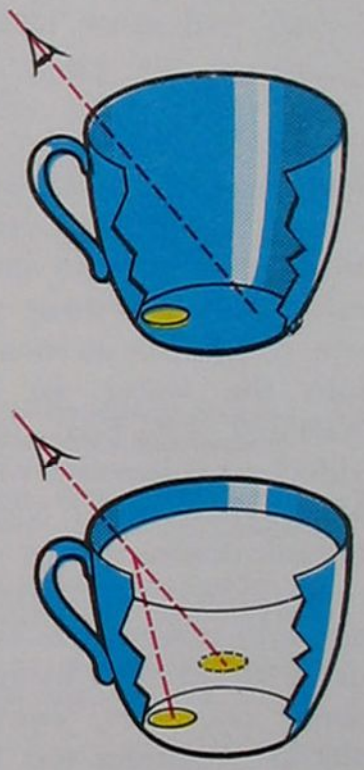
Light travels in straight lines. It will not go round corners and for this reason objects exposed to a single strong source of light cast shadows. Light travels by radiation. To a scientist, it is a form of radiant energy and is closely related to heat rays, X-rays, and even radio waves.

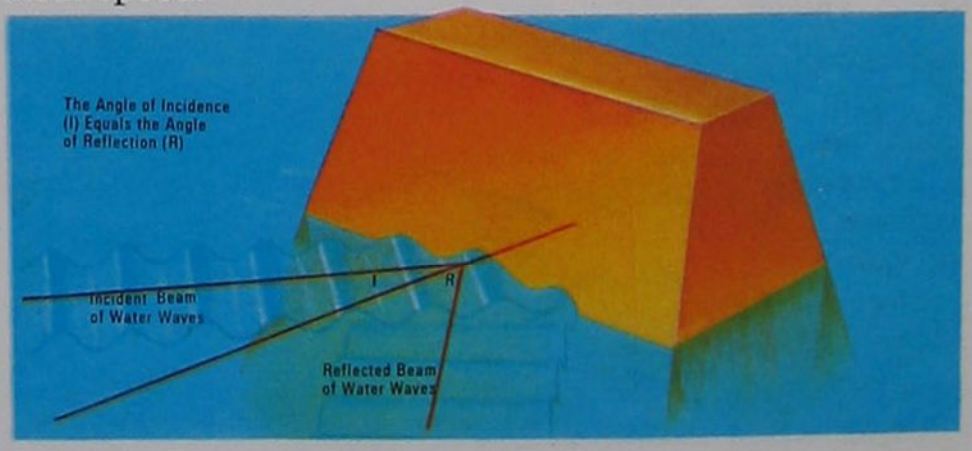
Early scientists believed that light is made up of millions of tiny particles called *corpuscles* travelling at enormous speeds.



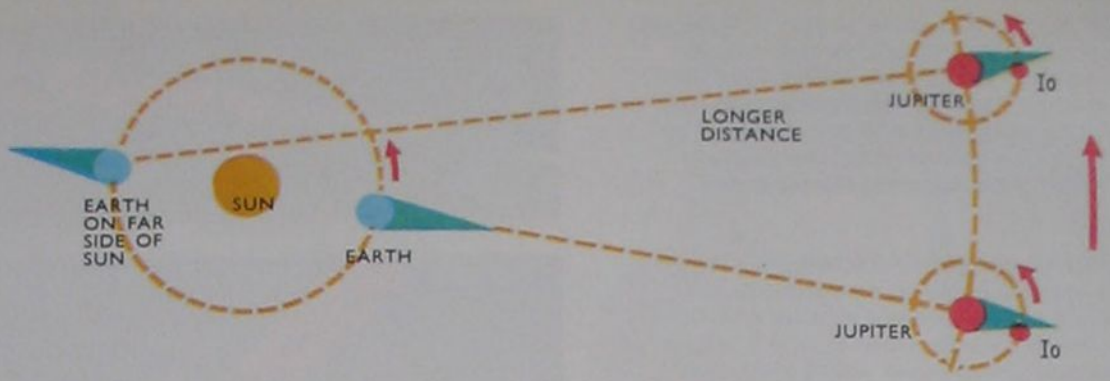
Light rays can be bent, or *refracted*, as they pass from one transparent substance to another, e.g. from air to water. The amount and direction of refraction depends upon the substances involved.

Right: Refraction can be demonstrated by the 'cup and coin' trick. A coin is placed at the bottom of an empty cup so that it is out of sight of a viewer. If the cup is then filled with water the viewer can see the coin, though it is still in the same position. This is because the light rays from the coin have been bent at the surface of the water so that they do enter the eye. Refraction of light can also be seen in a straight stick in a pond which appears to be bent below the water line.





Both waves and particles obey the laws of reflection. The beam of water waves is being reflected by the wall. Light rays are reflected by mirrors in the same way. The angle at which a ray of light strikes a mirror (the angle of incidence) is the same as the angle at which it is reflected back (the angle of reflection).



Light travels at a speed of about 186,000 miles per second through a vacuum or in outer space. The first reasonably accurate measurement of the speed of light was made by the Danish astronomer Olaus Röemer in 1676. He noticed that Io, one of Jupiter's moons was blocked from the Earth's view at certain intervals of time. He then discovered that these eclipses occurred slightly later than expected when the Earth was on the far side of the Sun. Röemer reasoned correctly that the delay was caused by the light taking longer to travel the extra distance. As he knew the distance involved (about 186,000,000 miles) he was able to calculate the velocity of light. It was not until almost 200 years later that Röemer's result was verified by the Frenchmen Fizeau and Foucault.

Reflection of a ray of light by a mirror seemed to support this theory; they thought that each corpuscle 'bounced' off the surface of the mirror in much the same way that a rubber ball bounces off a wall. The angle at which a ray of light strikes a mirror (the angle of *incidence*) is exactly the same as the angle at which it is reflected back (the angle of *reflection*).

The British scientist Sir Isaac Newton supported the corpuscular theory of light, and because of his influence the theory held sway during the 1700's. But in the 1800's, most scientists returned to the earlier theory of the Dutch astronomer Christiaan Huygens who suggested that light consists of waves. For a while, the whole world of science argued over who was right. The supporters of the wave theory finally won, because they could satisfactorily explain certain properties of light which the corpuscular theory could not.

According to the wave theory, light radiates out from its source as a series of waves—rather like the ripples in the surface of a pond spread out from a stone's splash. Like water waves, light waves consist of a succession of crests and troughs. The distance between any two successive crests (or troughs) is called the *wavelength* of the light. These wavelengths are so small (about a few millionths of an inch) that they are measured in special units. The number of waves passing a point in space every second is the *frequency* of the light.

Light travels at an enormously high speed—in fact at the fastest speed known to man. In a vacuum or in outer space, light travels at about 186,000 miles a second. In air or water or glass, light travels very slightly slower. The denser the medium, the slower it travels. This slowing down bends the light waves slightly, and so a light ray passing into water or glass is bent. This bending is called *refraction* and it is how lenses focus beams of light. (See Lens.)

The wavelength of light also determines its colour. For example, red light has a longer wavelength than has blue light. When white light from the Sun, which consists of a mixture of all wavelengths, passes through a glass prism, each wavelength is refracted to a slightly different extent. As a result, a prism can split white light into its component colours or *spectrum*. A rainbow consists of the Sun's spectrum formed when light is reflected round the inside of millions of rain drops.

Top right: 'White' light is a mixture of light of different colours—violet, indigo, blue, green, yellow, orange and red. A prism is able to separate 'white' light into its component colours because the various coloured rays have different wavelengths and are refracted by different amounts as they pass through the specially shaped glass. Violet light is refracted the most, red light the least.

Bottom right: Objects appear coloured because they absorb a portion of the light falling on them and reflect the remainder. A blue object reflects blue light and absorbs the other colours. Objects which reflect all of the light appear white, those which absorb all of the light appear black.

According to modern quantum theory, all kinds of radiation consist of tiny 'packets' of energy called *quanta* which travel as waves. A quantum of light is called a *photon*, and it corresponds in many ways to one of Newton's corpuscles. Photons travel as waves—and so Huygens' wave theory was also basically correct.

Talking points

*The 'white' light that comes from the Sun is made up of a number of different colours—the colours of the spectrum. How many colours are there and what are they?

*The Sun is a ball of white hot burning gases. How do artificial sources of lighting such as candles and electric bulbs produce light?

*Light travels in straight lines and cannot go round corners. If something casts a shadow in sunlight, the area that is shaded does not fall into complete darkness. What property of light prevents this from happening?

Articles to read

Candles; Colour; Energy; Infra-red rays; Heat; Lens; Newton; Prism; Rainbow; Sun; Ultra-violet rays.

Lighthouses Navigating a ship close to shore is difficult enough in the daylight. In the dark and in fog, it can be very dangerous. Lighthouses are built at ports and harbours, on headlands, or on rocks some way from shore to warn sailors that that they are approaching land or dangerous waters. They are tall towers with a steady or flashing light on top.

Lighthouses are sometimes built on rocky islets in the sea. Others are placed on high cliffs.

The light, of course, is not much use in the fog. For this reason, most lighthouses also have a foghorn and a radio beacon, which sends out radio signals

Lighthouses are recognized by the kind of beams, or *signals*, they give out. The flashing lighthouse, which is the most common type, gives out a series of flashes, alternating with periods of darkness. Each lighthouse has its own characteristic 'pattern' of flashes.

The light in the lighthouse is provided by a lamp and a lens system, or *optic*, which concentrates the light into a strong beam. It is housed in a glass-and-steel *lantern room*. In most lighthouses, the light is made to flash by rotating the optic around the lamp. The lamp may be lit either by electricity or by gas (acetylene).

Floating lighthouses, or *lightships*, are anchored near sand-banks, wrecks, and other obstructions. Like lighthouses, they have flashing lights, foghorns and radio beacons. Anchored *lightbuoys* mark the entrance and path of navigation channels.

Lighting Flaming faggots taken from his fire by early Man were probably the first torches ever used. The camp fire itself, although built principally for protection and warmth, was also the first form of artificial lighting. The earliest form of

street lighting used torches called *flambeaux*, which consisted of twisted fibre coated with an inflammable material. These torches were used in the Middle Ages: they were usually fixed in metal holders on the outside walls of houses.

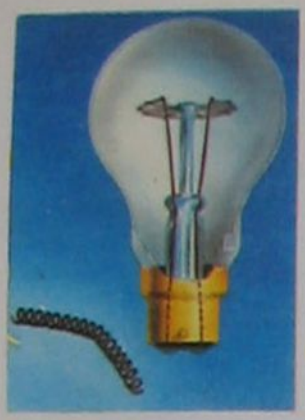
Oil lamps were invented many thousands of years ago. The familiar wick came into use as long ago as 1000 B.C. Four or five hundred years later crude oil lamps came into general use in the homes of the time. They consisted of a saucer-shaped vessel containing nut or olive oil in which a wick made from vegetable fibre was placed. Mineral oil lamps were being made soon after the birth of Christ.

The accidental discovery that a round glass chimney reduced flickering greatly improved the performance of oil lamps. This was made late in the 18th century. Further improvements were made—particularly in the late 19th century. The simple kerosene lamp, one of the later designs, was widely used in rural districts until the 20th century. It had a plain glass chimney and a flat wick in a perforated metal holder.

From about the time of the birth of Christ an alternative form of lighting—candles—was in use. Indeed candlemaking is probably man's oldest industry. Flax threads coated with wax were used in the earliest candles. During the 18th and 19th centuries the discovery of new materials such as spermaceti, stearine and paraffin greatly improved the performance of candles.

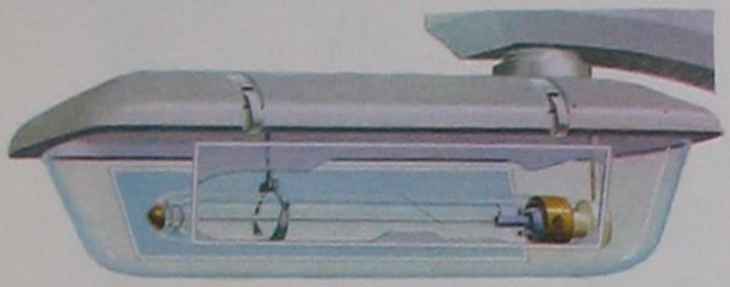
Despite this, both candles and oil lamps quickly fell into disuse once gas lighting had become firmly established, which was by the beginning of this century. The invention which perhaps more than any other made this possible was that of the gas mantle by Carl Auer von Welsbach. This consisted of a metal oxide skeleton containing the rare earth elements thoria and ceria. This mantle was heated by placing it over the gas flame and a brilliant greenish light was given off by the rare earths.

The development of artificial lighting: 1. A rushlight, the earliest form of candle; 2. A wick spout oil lamp; 3. 18th century lace-maker's lamp; 4. A paraffin oil lamp; 5. Gas street lighting; 6. Swan's carbon filament lamp; 7. One of Edison's early carbon filament lamps; 8. A carbon arc lamp.



Left: A modern electric light bulb consists of a thin filament of tungsten mounted in a vacuum or gas-filled bulb. Tungsten has an extremely high melting point.

Below: In a discharge lamp there is no filament. Instead, gas is made to glow brightly by passing an electric current through it.



Today, of course, electric lighting is used almost everywhere. The earliest electric lamps consisted of two carbon rods between which there was a brightly glowing electric arc. They were too bright for use in the home and today are used only in cinema projectors and theatre spotlights. The familiar electric light bulb consists of a thin filament of tungsten mounted in a vacuum or gas filled bulb. The filament glows brightly when electric current flows through it. Better efficiency can be obtained by using what are called discharge lamps. They consist of glass tubes containing sodium or mercury gas. An electric current in the form of free electrons is given off from a heated cathode at one end of the tube and flows at high speed through the gas to the other end of the tube. As they travel down the tubes the electrons strike gas atoms causing them to glow brightly. The light from sodium lamps has an orange tint: that from mercury lamps is blue/green.

In fluorescent strip lamps, a later development, the light given off by the atoms is not used directly. Instead, it excites the atoms in a thin layer on the inside surface of the glass envelope of the lamp. Lamps of this type can be made to give a light that is much closer to true daylight, or is much more pleasing to the eye. They are also much more efficient and last much longer than other types of electric lamp.

Lightning is one of the most spectacular sights of nature. It is simply a large spark of electricity—a current flowing between a cloud and the earth, between clouds, or within a cloud. The blinding flash and thunderclaps are the effects of disturbances of the air by electrical discharge. The huge *voltage* (electrical 'pressure') necessary to send electricity across air—about a million volts for a mile—is built up as a thundercloud is formed. (See Thunderstorms.) Rising drops of moisture or ice collide with others and with gas molecules, and the friction disturbs the balance of electrical charges. The surfaces

Left: Forked lightning from cloud to earth. Centre: Sheet lightning (a flash of lightning within a cloud). Right: Fire-balls (isolated patches of illumination).

of the cloud become charged with electricity, which eventually discharges in a flash of lightning.

Forked lightning, from a cloud to the earth, appears jagged because it forms in a series of steps, each about 10 yards long, as it seeks the easiest path to earth through the air. Sometimes after one of the steps the stroke branches out. *Sheet lightning* occurs within a cloud, between the upper and lower layers, which have different charges. *Ball lightning*, or *fireballs*, is a rare occurrence, and is not yet fully understood.

Although the flow of current in a lightning flash is huge, the actual quantity of electricity is small, because the current flows for only a fraction of a second. But it can cause serious damage, setting trees and houses on fire, and electrocuting and even killing living things.

Lille is an industrial city in the north of France, near the Belgian border. It stands on the River Deule, and has 200,000 inhabitants. Textile mills, producing linen, cotton, woollen and other fabrics, have been located in Lille for hundreds of years. Iron and steel works use coal from nearby coalfields. Railway, farm and factory machinery is manufactured. The University of Lille has fine buildings, and the city has a famous art museum.

Lily family of plants (scientific name *Lilaceae*) contains more than 200 different *genera* (groups) and several thousand *species* (individual types). A few of these are grown as vegetables, notably the onion, garlic, leek and asparagus. The rest are cultivated for their beautiful flowers. These include the delicate lilies-of-the-valley, fragrant hyacinths, brilliant tulips and about 80 species of true lilies. Most members of the lily family grow from bulb-like underground storage stems. This is the part of the onions that we eat. Water lilies belong to a different family altogether.

Lilies are widely grown for their beautiful and often colourful flowers, like these of *Lilium Shuksan*. Many of them will flourish in temperate regions.

True lilies usually have large blooms that open like the end of a horn. They may be vividly coloured or spotted or white like the Madonna lily and Easter lily, traditional symbols of purity and rebirth. True lilies are found in the north temperate zone, especially in Asia.

Lincoln, Abraham (1809-1865) was one of the greatest presidents of the United States. He prevented the United States from splitting into two countries during the American Civil War, and won a long battle to prevent the spread of slavery. Lincoln was able to express himself so clearly and forcefully and was so sincere that he persuaded many people to support his ideas.

Lincoln was the son of a simple farmer and carpenter. His birthplace was a log cabin on his father's farm in Kentucky. As a boy he worked hard on the farm and spent less than a year at school. In 1831 he left home for New Orleans. He moved to a village called New Salem, where he became a clerk in a shop. After a few months the shop was closed and Lincoln tried various occupations.

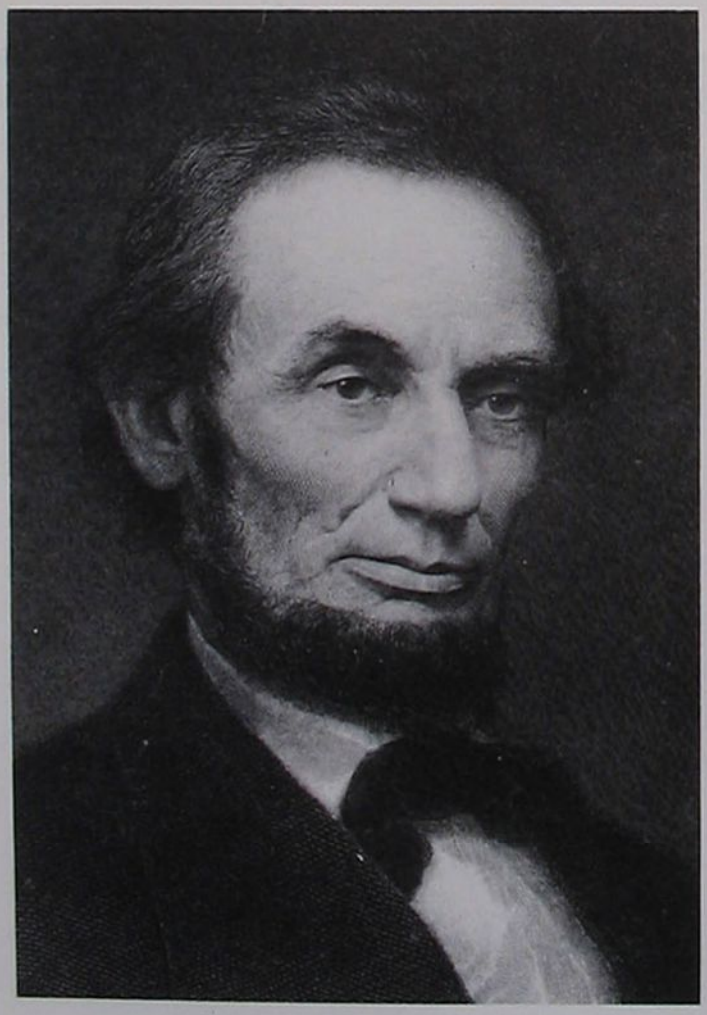
One of Lincoln's chief assets as a politician was his reputation for honesty. This came from an incident that happened in New Salem in 1835. Lincoln had entered into partnership with a man called William F. Berry. Together they had bought a store on credit. It did not do well and the debts began to mount up. Then Berry died and Lincoln was left with debts of over a thousand dollars. Lincoln worked hard and eventually paid off all this debt. This gave rise to his nickname of 'Honest Abe' that was to stay with him for the rest of his life.

In 1834 Lincoln was elected to the state legislature (council). The same year he started to study law, and he practised as a lawyer for some years. In 1847 he was elected for two years to the House of Representatives (the lower house of the United States parliament).

In 1854 the law limiting the amount of slavery was changed. Lincoln thought slavery was evil and joined the Republican party, which opposed it. In 1860 he was elected president, but nearly all his votes came from the northern states. Ten southern states decided to set up their own union, called the Confederate States.

The next year the American Civil War broke out between the Confederate States and the states that remained part of the Union. Lincoln stated that his aim in the war was to preserve the Union, not to end slavery. Lincoln was re-elected president in 1864 and the Confederates surrendered shortly afterwards. But he did not live to see the southern states re-joined to the north. A few days after the end of the war, he was shot dead in a Washington theatre.

An engraving of Abraham Lincoln, the 16th president of the United States. He started life in a pioneer's log cabin.



Lincolnshire, a county in the east of England, is the second largest in the country with an area of 2,600 square miles. It is divided into the administrative districts of *Parts of Holland, Parts of Kesteven* and *Parts of Lindsey*. Their county towns

Charles Lindbergh (centre) made the first non-stop flight across the Atlantic Ocean from New York to Paris in 1927. In his plane *The Spirit of St Louis* Lindbergh flew 3,600 miles in 33½ hours.

are, respectively, Boston, Sleaford and Lincoln. The total population is 808,400.

Most of Lincolnshire is low-lying, flat and fertile. The Fen region around the Wash, on the east coast, is drained by the Nene, Welland and Witham rivers, and intersected by canals. Other rivers are the Humber and Trent. The main crops are wheat, barley, potatoes and sugar beet. Bulbs are also grown. Grimsby is the chief fishing port, and there is specialized engineering in Grantham, Stamford and Gainsborough.

Lindbergh, Charles Augustus (1902-), an American airman, made history on 20th May, 1927. On that day he made the first solo, non-stop aeroplane flight across the Atlantic Ocean. He flew from New York to Paris in a single-engine plane called *The Spirit of St Louis*. The flight took 33½ hours. Today the same journey takes less than 8 hours. Lindbergh's flight gained him world-wide fame and a prize of 25,000 U.S. dollars.

In 1932, Lindbergh was involved in a tragedy that shocked the world. His baby son was kidnapped and murdered. Lindbergh was born in Detroit, in the United States.

Linen is cloth made from fibres in the stalks of flax plants. It has a crisp 'feel', is fairly strong, and has quite a shiny appearance. It is widely used to make table 'linen'—tablecloths and napkins—and dress materials. Linen is a useful material for handkerchieves and towelling, too, because it readily absorbs water. Some of the finest linen is produced in northern Europe. Belgian, French, and especially Irish linens have become world famous.

Harvesting flax for making linen is done by pulling the plants from the ground by hand or by machinery. The seeds are removed from the stalks *(rippling)*, and the stalks are allowed to rot either on the ground or in shallow ponds *(retting)*. Retting breaks down the substances holding the fibres in the stalks.

After retting, the stalks are dried and beaten to separate the fibres *(scutching)*. Then the fibres are combed out straight *(hackling)*, gathered into slivers, and made into *roving* for spinning.

Linnaeus, Carolus (1707-1778), was a Swedish botanist who introduced the system of scientific naming and classification that we use today. Linnaeus showed that every plant or animal could be given a two-part Latin name. The first part indicates its *genus* (group), the second indicates its *species* (specific type within the group). He published the system for plants first in *Species Plantarum* (1753), listing 24 groups of plants divided according to their reproductive systems. In *Systema Naturae* (1753) he extended the system to the animal world.

Linnaeus was both a professor of botany and of medicine at the University of Uppsala in Sweden. He made many journeys through Sweden and Lapland collecting plant specimens. His *herbarium* (plant collection) was brought to England after his death. Carolus Linnaeus is Latin for the scientist's real name, Karl von Linné.

Lion The lion is one of the biggest members of the cat family. With its powerful roar and handsome appearance, it is often called the 'king of the beasts' or the 'lord of the jungle'. It is certainly one of the strongest and most fierce of all wild animals, and few other creatures are safe from it when it is hungry. But the lion does not live in the jungle, and some tigers are bigger.

A fully grown male lion may measure over 9 feet from nose to tail and weigh up to 500 pounds. It stands about 3½ feet high at the shoulder. Lionesses (female lions) are generally smaller. They do not have the mane of long hair on their shoulders that gives a male lion its regal appearance. Most lions are yellowish-brown in colour. The mane may be darker.

Lions live in the open plains and scrublands of Africa and a small part of India. They live in family groups—called *prides*—of 4 to 20. They hunt together, eating all but the largest of other animals. After a good meal, a lion may not kill and eat again for a week.

Lisbon is the capital of Portugal. It is also the country's busiest port and chief manufacturing centre. It exports olive oil, canned sardines, wine and cork. Chemicals and petroleum products, textiles, pottery, soap and shipbuilding are major industries. Lisbon spreads over several hills overlooking the estuary of the River Tagus. Centuries-old landmarks and narrow, winding streets in the Alfama district attract many tourists. Broad avenues cut through the newer sections.

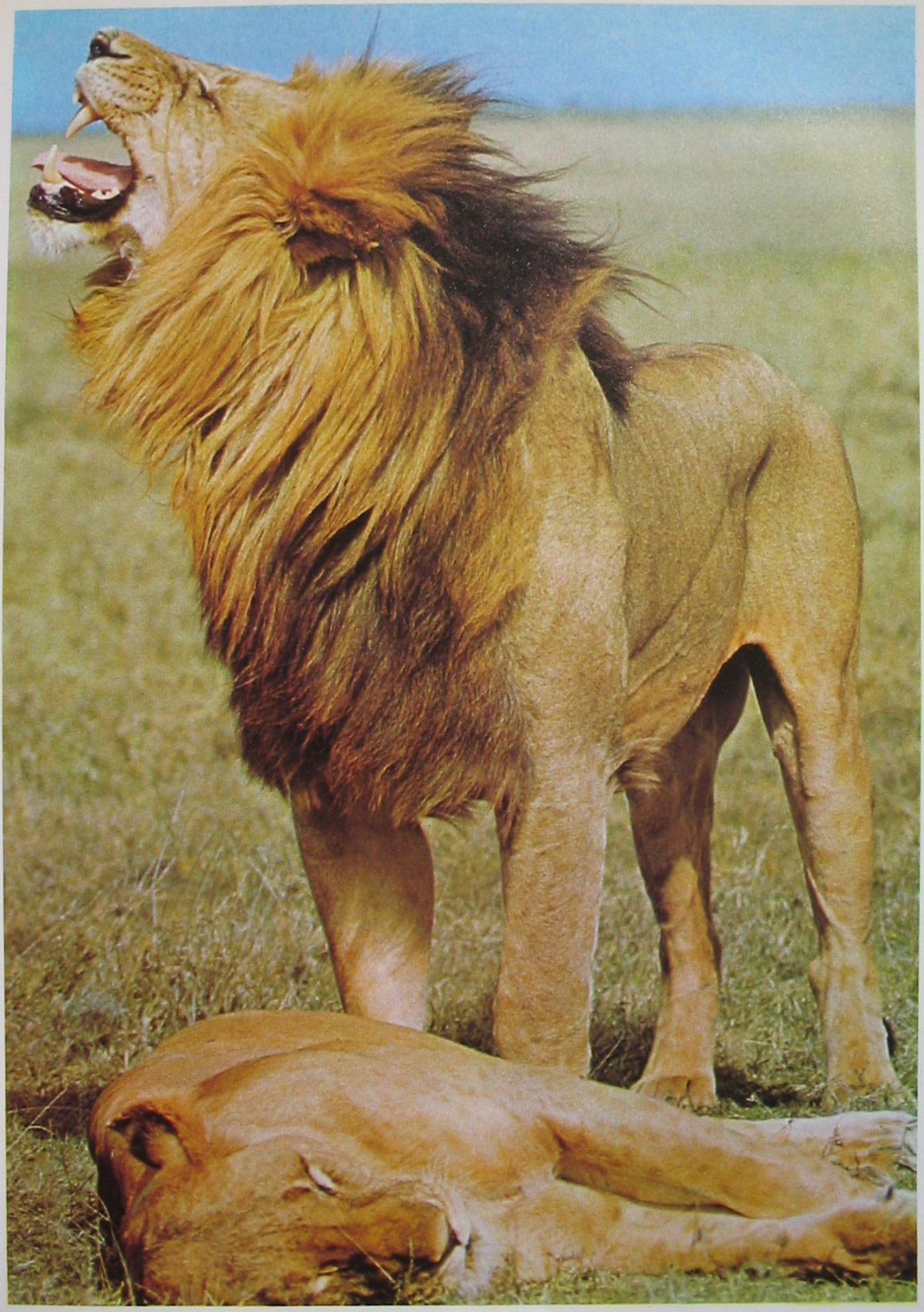
Lisbon was known as Olisipo in ancient times. The Romans, Visigoths and Moors, among others, ruled it before King Alfonso I won it for Portugal in 1147. It became the capital in 1260. A great earthquake damaged much of the city in 1755. In recent years floods have caused more destruction. Lisbon has a population of 820,000.

Literature, in its broadest sense, refers to any written material including such things as advertisements, newspapers and catalogues. The term is normally taken to describe written works of artistic merit which have some value through their style or emotional content.

Literature can be divided into two types—prose and poetry. Poetry is the expression of ideas or a story in a form which has a *metre* (rhythm) and often rhyme. Poetry is appreciated for the beauty of the language used as well as for the ideas or stories that it contains. The earliest poems were *epics*; long stories of the heroic deeds of gods or men. The *Iliad* of Homer is one of the best known examples of this type of poem and tells the story of the siege and fall of Troy.

Throughout history, styles of poetry have constantly changed. Poets have used their pens to express philosophical and romantic ideas; to criticize society; and to make people more aware of the beauty of nature. Modern poetry often disregards

A pair of lions. Curiously, it is the smaller lioness that generally hunts and kills the prey.



metre and rhyme and concentrates on expressing strong emotions in the most forceful way.

Prose is the everday language that we speak, but prose literature has to communicate stories or ideas in a clear way that is enjoyable to read. The most common form of prose is the *novel*. A novel is a story of fictitious characters and events which relate to real life. It is normally quite long and may have a complex plot.

The first novels were written by ancient Greek and Roman authors and were often humorous. But for a long time poetry was regarded as the proper medium of expression for serious or noble stories and prose was only used to write about mundane matters. The novel in its modern form came into being in the 1700's, although satirical books such as Cervantes' *Don Quixote* and Rabelais' *Gargantua* and *Pantagruel* were written in the 16th and 17th centuries. The 1800's was the great period of the English novel when authors like Walter Scott, Charles Dickens, the Brontë sisters, and William Thackeray were writing.

Biographies, factual accounts of the lives of important or interesting people, have always been a popular form of literature. One of the earliest biographers was a Roman called Suetonius who wrote the *Lives of the Twelve Caesars* at the beginning of the 1st century AD. When a person writes his own biography it is known as an *autobiography*. This form of writing is especially popular with modern politicians who seek to justify themselves.

Drama is another form of literature. In drama, all that is written down is spoken by actors on a stage, although there may sometimes be a narrator who explains what is happening. Early plays were written in verse and William Shakespeare, the greatest English playwright of all, often made his characters speak in verse.

Other forms of literature include *short stories*—short fictional novels which are concisely written and may describe just one situation. The *diaries* and *letters* of famous people are also sometimes published, and give us insight into the person and a knowledge of the times in which he lived.

Location map of Lithuania.

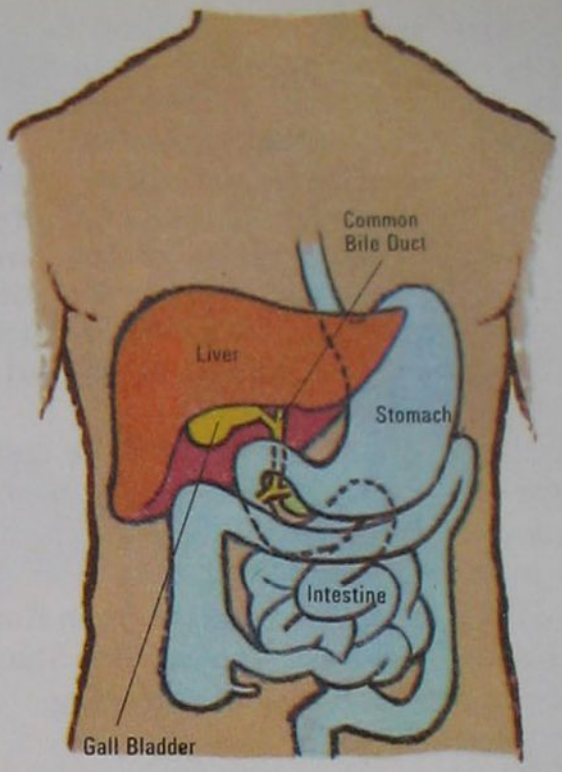
Lithuania, on the Baltic Sea, was annexed as a republic within the Soviet Union in 1940. It has 3,128,000 people. The countryside is mostly low, with many forests and lakes. Farmers produce rye, oats, potatoes, sugar beet and flax, and raise pigs, dairy cows and sheep. Under the Russians people have been resettled and industry expanded. Paper and wood products, processed food, machines and electrical equipment are manufactured in Vilnius, the capital, Kaunas, and the port of Memel. The Lithuanian language and culture are very old. Once a vast state ruled by grand dukes, Lithuania was united with Poland for several hundred years. It proclaimed its short-lived independence in 1918.

Liver The liver is the largest gland in the body (see Gland). It is situated just below the diaphragm, with its lower end touching the intestines and the right kidney. It weighs between three and four pounds, and is a dark-red or chocolate coloured soft mass.

The liver acts as a chemical factory. One of its many jobs is to store and process food materials coming from the digestive system. A blood vessel called the *hepatic portal vein* carries blood direct from the intestines to the liver. The liver stores

vitamins A, B and D, and minerals such as iron and copper. This is why the liver and liver oils of animals are valuable sources of iron and vitamins. The liver also removes excess glucose from the blood, converts it into animal starch, or *glycogen*, stores it, and re-converts it into glucose when the body demands more sugar. Protein-forming materials cannot be stored; they are converted to carbohydrates.

The liver also produces a digestive fluid called *bile*. This collects in the *gall bladder* and runs down the *bile duct* to the intestine to help in the breakdown of fats. An important liver function is the production of *urea*, a waste product containing nitrogen, from broken-down protein in the blood-stream. The urea passes back into the blood and is *excreted* (got rid of) by the kidneys (see Kidney).



The liver is sometimes called the body's chemical factory. One of its many tasks is to store and process food materials coming from the digestive system.

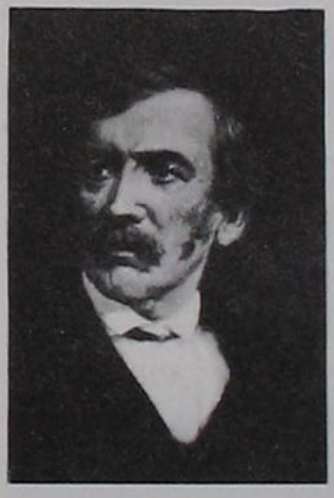
Liverpool is a city, county borough and seaport in the county of Lancashire, England. It is situated on the west coast on the north shore of the estuary of the River Mersey. It is one of the world's great trading centres, and with 38 miles of docks and quays is the second largest port in Great Britain. Development of the city began in the 1600's and its population is now 607,000.

Liverpool is an important educational centre. A new Roman Catholic cathedral was completed in the 1960's. The 2½-mile-long Mersey Tunnel, connecting with Birkenhead, is an engineering marvel.

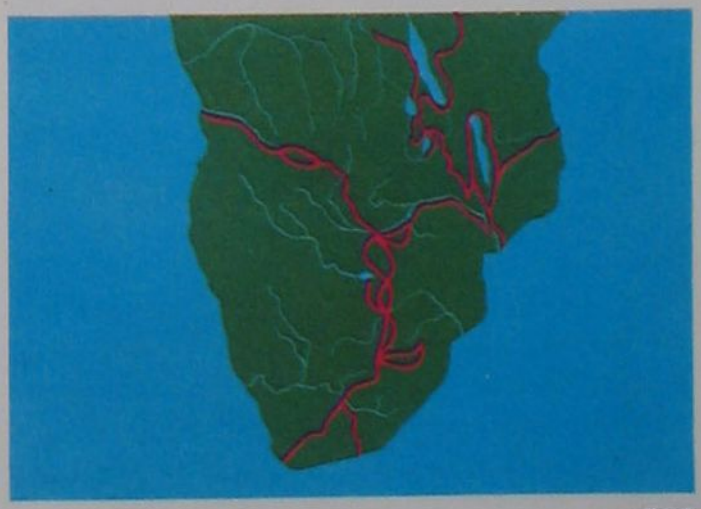
Livingstone, David (1813-1873), was a Scottish missionary and explorer. His original ambition was to bring Christianity to Africa, but he is better known for his explorations of that continent.

In 33 years of travelling, Livingstone covered 30,000 miles of country previously unknown to Europeans.

Livingstone was born in Lanarkshire and worked in a cotton mill before studying medicine and theology. He was accepted by the London Missionary Society,



David Livingstone (left) combined missionary work with exploration in Africa. He was interested in tracing sources of rivers, notably the Zambezi and the Nile. As the map of his journeys (below) shows, he made extensive journeys into the interior of Africa. Lack of news of his whereabouts once aroused world interest and an American newspaper financed an expedition, led by Stanley, to find him.



and took his doctor's degree in 1840.

He was first sent to Bechuanaland (now Botswana) and in 1844 married the daughter of a missionary. He discovered the Victoria Falls, and lakes Ngami, Malawi, Shirwa, and Bangweulu, and was the first European to travel the length of Lake Tanganyika. During a visit to London, he left the Missionary Society and returned to Africa as consul at Quelimane, in Mozambique.

In 1866, he set out to find the source of the River Nile. Because Livingstone was known to be ill, an expedition under the journalist H. M. Stanley was sent to look for him. When the two men finally met at Ujiji on Lake Tanganyika, Stanley uttered his well-known greeting: 'Dr. Livingstone, I presume'.

Although weak with disease, Livingstone refused to return to the coast with Stanley. He continued exploring the region for another year and then returned to Ujiji. In 1872 he made a last attempt to find the source of the Nile. He reached Lake Bangweulu in Northern Rhodesia (now Zambia), and died there in 1873. His African companions thought so highly of him that they carried his body all the way back to Quelimane over 500 miles of rough country.

Lizards are reptiles closely related to snakes. Most lizards differ from snakes in that they have four legs. But some have no legs, and look very much like snakes. Legless lizards, such as the Slow worm, can be told apart from snakes because they have movable eyelids and external ears. And they do not have the deeply forked tongues of snakes.

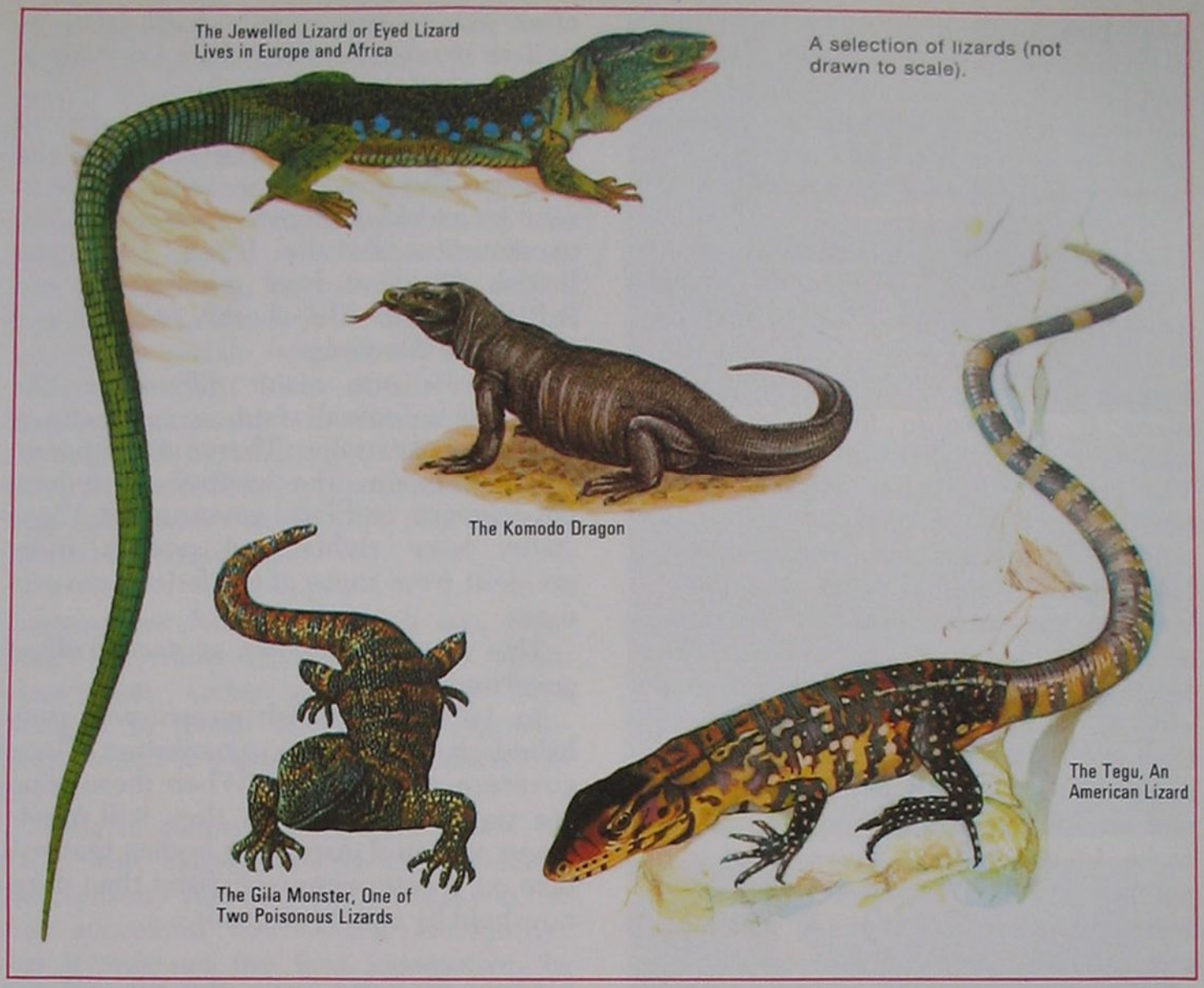
There are over 2,000 species of lizards living in tropical and warm temperate parts of the world. They range in size from about two inches up to the 10-foot-long Komodo dragons of Indonesia. Other large and fearsome-looking lizards include the marine iguanas that live on the shores of the Galapagos Islands. Some lizards are eaten as food, and lizard skin is used for making a fine leather for gloves, shoes and handbags.

Most lizards lay eggs, but a few species produce living young. Lizards generally eat insects and small animals, although some eat plants. The chameleon catches insects by shooting out its long tongue. Only one genus of lizards has a poisonous bite. This includes the gila monster, a stubby, 18-inch lizard found in the deserts of south-western U.S.A. The grooved teeth which carry the venom are far back in its mouth.

Most lizards live on the ground or in trees, but they get about in a great variety of ways. Geckos have special folds of skin on their feet for clinging to the branches among which they live. They can walk upside-down across a ceiling, or up a window-pane. Several lizards can run about raised up on their two hind legs. The flying lizard can even glide through the air by stretching out loose folds of skin like sails. Legless lizards wriggle about on the ground in much the same way as snakes.

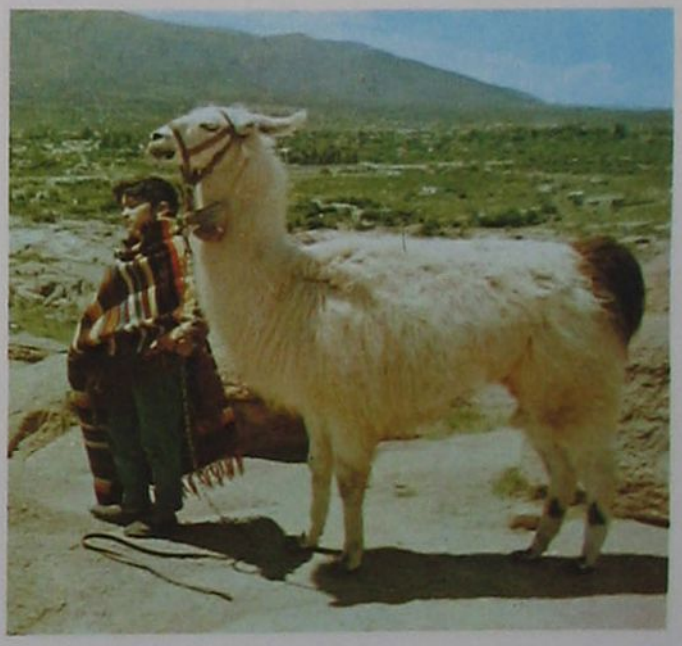
Lizards have unusual ways of escaping from enemies. If a lizard is seized by its tail, the tail usually drops off and the animal escapes. Later, a new tail grows to replace the lost one. The Chameleon simply hides itself by changing colour to merge with its surroundings. Some lizards frighten away attackers. The Australian frilled lizard erects a great frill around its neck and hisses. And the Texas horned lizard squirts blood from the corners of its eyes at an attacker.

Llama The llama is a domesticated member of the camel family that lives in the mountains of South America. Like its close relatives in South America, the alpaca, guanaco and vicuna, the llama has no hump. It grows to a height of four to five feet at the shoulder. It has a long neck and shaggy hair. South American Indians use the hair to make cloth and the hide to make sandals, and they eat the llama's flesh. Male llamas are


The Jewelled Lizard or Eyed Lizard
Lives in Europe and Africa
A selection of lizards (not drawn to scale).
The Komodo Dragon
The Tegu, An American Lizard
The Gila Monster, One of Two Poisonous Lizards

used as pack animals over rough, mountainous country. No llamas live in the wild today, but some guanacos and vicunas still do. The hair of vicunas gives extremely soft, valuable cloth.

Below: The llama is an American relative of the camel and has been used as a pack animal by the South American Indians for over a thousand years. It can carry loads of up to 100 pounds at high altitudes in the Andes where the air is too thin for other animals. The Incas used llamas to work in their silver mines.



Lobsters and crabs belong to the class of animals called *crustaceans*. They have a hard outer shell called a *carapace* that covers the back and the head. Lobsters have long bodies with tails, while crabs have a disk-shaped body and no tail. Both animals have five pairs of jointed legs. The front pair of legs are larger than the others and are armed with pincers or claws. These are used for defence and for cutting and tearing food.

Lobsters and most crabs live in the sea. But some crabs live in fresh water and others spend long periods of time on dry

land. Lobsters and crabs feed mainly on dead animals and vegetable matter, although they will sometimes catch small sea creatures. Both lobsters and crabs are highly prized as food and are fished for commercially all over the world.

Local government Most states are so large that the government is remote from ordinary people. The capital city, the seat of the government, may be a long way off, and the things the government is responsible for seem far removed from the lives of most citizens. The President or Prime Minister has no time to see that the road outside one particular house is properly repaired. So all large nations have local government bodies which are responsible for smaller areas and for every-day affairs. These local governments are created in the same way as the national government. Usually they are elected in a democracy and appointed in a dictatorship. But this is not always the case. There are democracies in which local government is appointed by the elected central government. And there are states in which local governments are elected while the central government is not.

A local government body may govern an area as small as a village or one larger than some nation states. The Greater London Council governs nearly eight million people and spends over £300 million a year. The responsibilities of local government differ from country to country. In most countries education is organized by the central government, but in Britain it is run by local government. There are usually local taxes as well as grants of money from the central government.

The smallest local government area in Britain is the parish. The largest is the county. These are more than a thousand years old. Colonists took the system to America. So the U.S.A. has many British forms of local government and British officials like sheriffs, mayors and justices of the peace.

There is one major difference. The U.S.A. is a federal state, as are Switzerland and Australia. There are separate states between the central or federal government, and local government. These states have rights and powers independent from those of the federal government.

This system is known as *decentralized* government.

In 1972, the British government published plans for the re-organization of local government in Britain. When these plans are put into operation, they will create larger *regional* governing bodies that will take on greater responsibilities than those now held by county councils.

Talking points

*What kind of local government do you have where you live? You will probably find that there are several councils that have responsibility for various matters.

*In some countries, for example the U.S.A., local government bodies have far more responsibilities than in others, e.g. Australia. What parts of our lives do you think should be controlled by local government?

*Members of local governments are often unpaid. They do the job to be of service to the community. Do you agree with this system or do you think that the task of governing should be left to paid 'professionals'?

Articles to read

Constitution; Democracy; Government; Parliament.

Locks and bolts From the time of the ancient Egyptians, man has used locks to protect his belongings. The ancient Egyptian, or *Brahma* lock had a wooden bolt with holes in it. When it was locked, wooden pegs fell into the hole. Turning a key raised the pegs and allowed the bolt

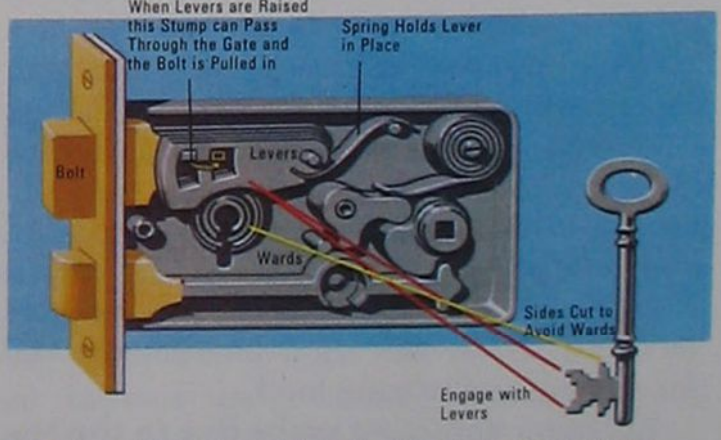

When Levers are Raised this Stump can Pass Through the Gate and the Bolt is Pulled in
Spring Holds Lever in Place
Bolt
Levers
Wards
Sides Cut to Avoid Wards
Engage with Levers

Diagram of a lock and key showing how the pattern of the key corresponds with the moveable parts of the lock.

to be withdrawn. The present *Yale* lock works on a similar principle. It has a central cylinder, attached to the bolt, that can only be turned when pins (pegs) are raised to a uniform height by a key.

The *warded* lock, invented by the ancient Romans, has a number of obstacles, or *wards*, which the key must pass before it can be turned. The *lever-tumbler* lock has levers that must be raised to a certain height before turning.

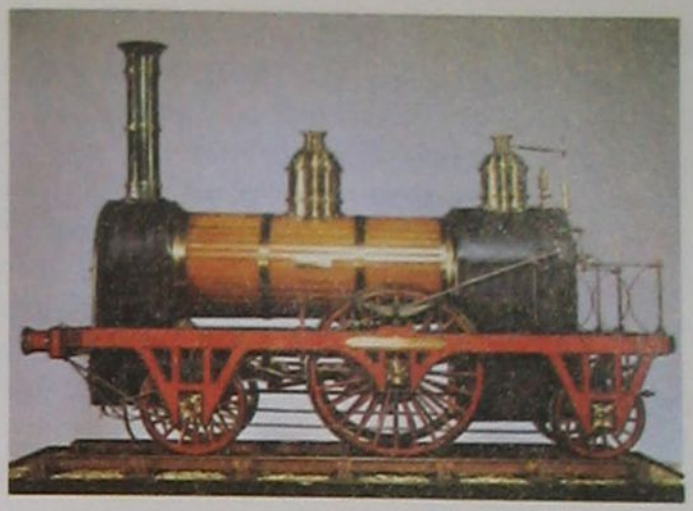
But the safest locks of all are *combination* locks, which have tumblers that are released by rotating a dial back and forth. For added safety, bank vaults have *time combination* locks that can only be opened at certain times

Locomotives Not many years ago, practically all trains were pulled by steam locomotives. Today most countries have changed to diesel and electric locomotives, which are cheaper and cleaner to run.

Modern *steam locomotives* work on much the same principles as George Stephenson's *Rocket* (1829), which was the first successful commercial locomotive. But it was not the first locomotive. In 1804, Richard Trevithick had built the first steam-engined vehicle to run on rails. And Stephenson himself had built several previous models.

Stephenson built the *Rocket* for a contest to find the best locomotive for a new Liverpool-to-Manchester railway. He had three rivals, but *Rocket* easily proved to be the best engine. On one run it reached the unheard of speed of 29 miles an hour!

Over the years, first Stephenson, then others made a great many improvements in locomotive design. Boilers were made bigger and the size and number of driving wheels were increased to give greater



The railway age was made possible by the steam locomotive. Two such locomotives are shown in the top pictures. Built almost one hundred years apart, the principle of operation is much the same in both. The two lower locomotives—one electrically driven, the other diesel powered—are examples of the types of motive power which are replacing steam.

power. By the 1930's, development reached its peak. In 1938, the British locomotive *Mallard* reached a world-record speed for steam of 126 mph.

In a modern steam locomotive, coal or oil is burned in the *firebox*. Tubes carry the smoke and hot gases through a *boiler*, where water changes to steam. The steam forces *pistons* back and forth in the *cylinders*. The pistons are connected to the *driving wheels* by connecting rods. The fuel and water for the firebox are carried in a towed *tender*.

The *electric locomotive* was first developed in Germany by Werner von Siemens, who opened an electric tramway in Berlin in 1881. The first model worked from live rails, but this was soon changed to a system of overhead wires. By 1890, electric locomotives using conductor rails were running on London's underground railway. Five years later, electric locomotives began mainline services in the United States.

Electric locomotives have great advantages over steam locomotives. They are always ready for instant use. They can accelerate and stop quickly, which is essential on routes with many stops. And they make no smoke or soot. In addition, the locomotives are very easy to handle and have many built-in safety devices.

The electric locomotive is driven by electric motors connected to the driving wheels. The current to power the motors is picked up either from an insulated third rail or from an overhead wire. The overhead-wire system is not affected so much by ice and snow as the other type. Two French locomotives with over-head pick-ups set a world-record speed of 205 mph in 1955.

Diesel locomotives first entered service in 1912, but they were not introduced on a large scale until the 1950's. Their power unit is a larger version of the diesel engine used in motor vehicles. (See Automobile.)

British Rail's Advanced Passenger Train undergoing trials. It will come into service in the late 1970's and will travel at over 150 miles per hour.

The main kinds of diesels—electric, mechanical, and hydraulic—are classified according to the way in which the power from the engine is transmitted to the wheels.

In the *diesel-electric*, the engines turn generators which produce electricity. The electricity powers motors to drive the wheels. The *diesel-mechanical* type has the same kind of transmission system—clutch and gearbox—as a bus. The *diesel-hydraulic* type has an automatic fluid transmission.

Gas-turbine locomotives are in service in some countries. Fuel is burned in their power unit to produce hot gases which spin the blades of a turbine. The drive from the turbine may be mechanical (gears) or electric (generators and motors).

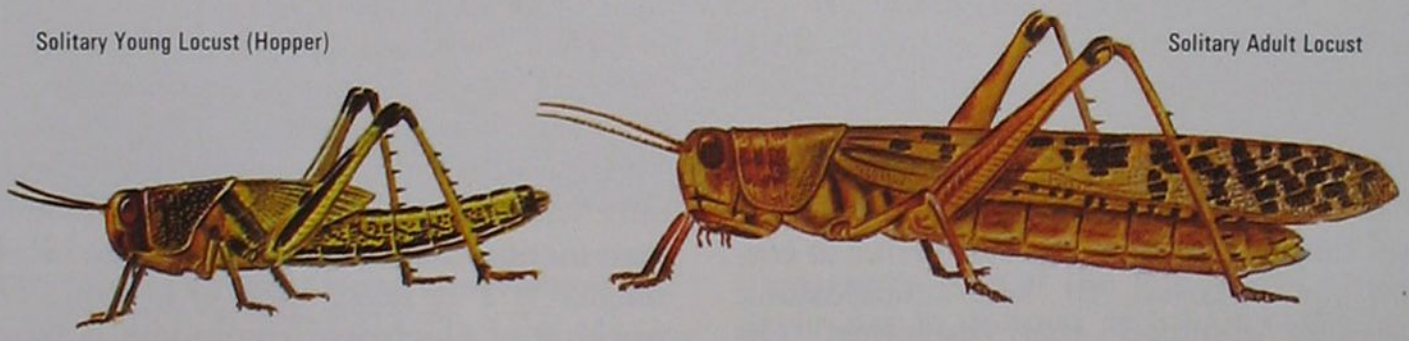
Locust The locust is an insect belonging to the grasshopper family (see Grasshoppers and Crickets). Locusts are found in the warm parts of Africa, Asia and south-eastern Europe. Locusts occasionally band together in huge swarms. When the swarm settles, the locusts devour every green leaf and blade of grass in sight, devastating crops and pastures.

Locusts may eat so much food that is needed by man that they have to be fought as if they were an invading army. Men use helicopters and light aircraft to track down locust swarms and spray them with poison. The young locusts, called *nymphs*, or *hoppers*, have no wings and they can be destroyed on the ground.

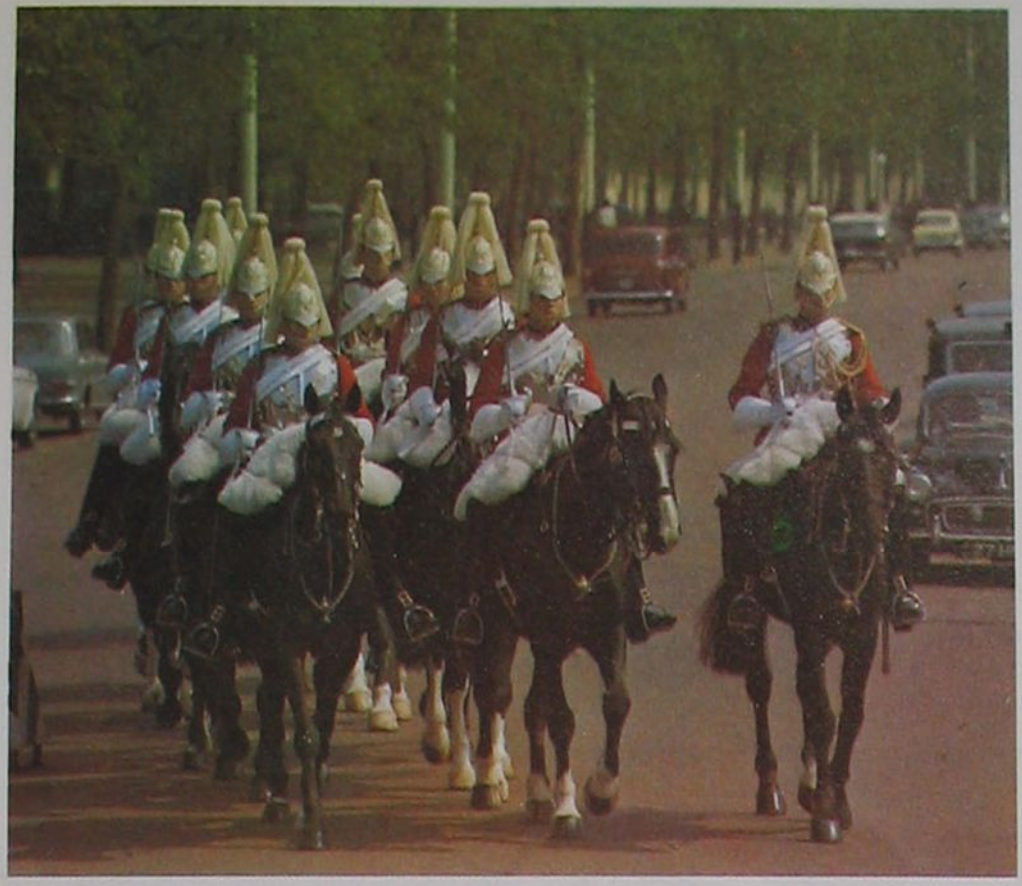
The wingless, hopping nymphs hatch from the eggs and normally develop into green, grey or brown adults. These locusts are said to belong to the *solitary phase*, and they do not swarm. But if nymphs are reared in crowded conditions, they become *migratory phase* locusts, which are black and yellow in colour. These are the ones which swarm.

Loess is a fine, yellowish soil. It is rather like clay, but contains tiny fragments of various minerals. In some places it forms thick layers of topsoil. Crops grow well in it. Some rivers have steep banks formed of loess.

Large amounts of loess are found in



Although individually harmless, locusts (above) are a terrible menace when they swarm in their millions and are carried by gusts of air to infest farmlands, and devour all the plants. Some idea of the fantastic menace can be gauged from the picture (left) of a car which is in the middle of the first wave of a large locust migration.



The traditional sights of London attract thousands of tourists every year. Above: A Cockney Pearly King wears his coat on to which many mother-of-pearl buttons have been sewn. Left: Soldiers of the Household Cavalry cross one of London's many parks.

three parts of the world. They are the Mississippi valley in the east-central United States, the Columbia plateau in the north-west United States, and China. In China, the Yangtze River and the Yellow Sea take their name from the colour of the loess which is carried by the water. The word *yangtze* means yellow. The mud is rich in minerals.

Logic is one of the branches of philosophy. It is concerned with the rules of reasoning and thinking, and the way we arrive at correct as opposed to false conclusions. Aristotle founded this discipline. His method was *deductive,* that is, it was based on outlining certain general truths, from which specific conclusions naturally and correctly followed. The basic form of deductive logic is the *syllogism,* an example of which might be:

All rivers run to the sea.
The Nile is a river.
Therefore: the Nile runs to the sea.

Later philosophers, including John Stuart Mill, identified another way in which we reach conclusions, namely, the *inductive* method. This is widely used in science. In this method, we gather a number of specific facts or truths that all point to the same general conclusion. If we collect enough specific examples we reason that the general conclusion is probably true—but we can never be entirely sure as in deduction.

In the 19th and 20th centuries a more abstract method, that of *mathematical* or *symbolic* logic, developed. Logicians no longer bothered with words, but worked only with letters and symbols standing for statements. Thus, the expression '-P Q' means 'if P is false, then Q is true'. The working of electronic computers is based on principles of mathematical logic.

London is the capital of Britain. It stands on both banks of the River Thames, in the south-east of England. Founded in

In prehistoric times, much of the area on which London now stands was swampland. Excavations for new buildings have unearthed the fossil remains of Mammoths, Sabre-tooth tigers and Hippopotamuses. London grew to its present great size mainly in the 1800's. Until then places like Paddington were small villages, separated from the City by fields and woods.

One of London's best known sights is the famous Tower Bridge spanning the River Thames. It can be raised or lowered to permit the passage of ships.

Celtic times and the *Londinium* of the Romans, the city has grown to become a vast commercial and trade centre with a population of 7,800,000. With an area of 720 square miles it is, with Tokyo and New York, one of the three largest cities in the world.

The city owes its prosperity to its geographical position on a navigable river and its large port facilities at a chief entry point into England from the mainland of Europe. The docks are visited by ships from every part of the world, and handle an immense volume of trade. London is a great distributing centre. Trunk railway lines and modern roads branch out in every direction to serve all parts of the country. London is also a great financial centre, and of major importance in banking and insurance.

The city is the seat of government of the United Kingdom and a royal residence. The Houses of Parliament (the Palace of Westminster) on the north bank of the Thames, are the home of both houses of the British Parliament. Buckingham Palace is used by the Queen when in London.

London is a great centre of culture and education. The University of London (1836), its associated colleges, and many technical institutes of higher education attract students from the Commonwealth and all countries of the world. The museums and art galleries contain valuable collections of unending interest.

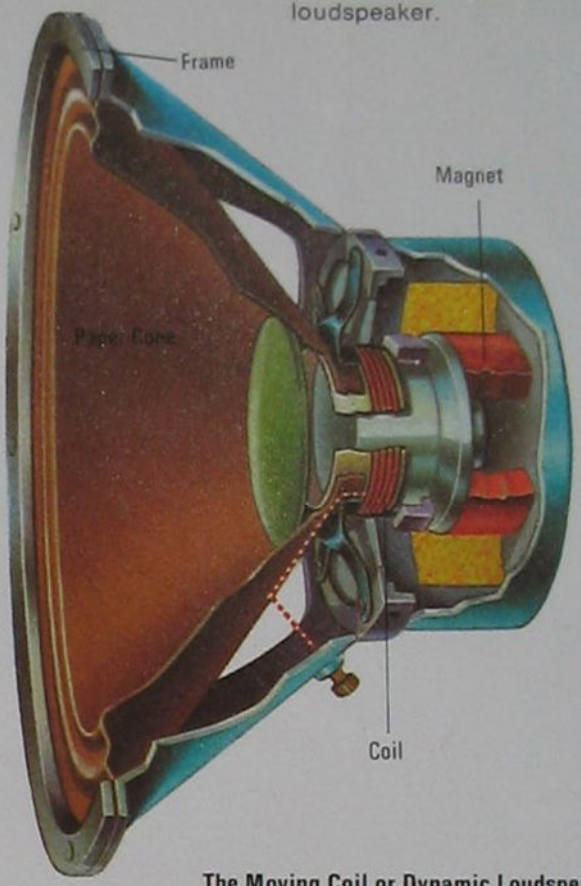
London is also a city of churches. Westminster Abbey has been the crowning place of almost all monarchs since the time of William the Conqueror and many are buried in the abbey choir. St. Paul's Cathedral, designed by Sir Christopher Wren, in the late 1600's, stands in the City of London.

Los Angeles is a city and port of the State of California, U.S.A. It stands on the Los Angeles River 18 miles from its mouth in the Pacific Ocean. With a population of 2,816,000 it is the third largest city in America, although first in area. Los Angeles is best known as a centre of the American film industry but it is also a leading industrial centre with large aircraft and food processing industries. It is a centre for art and education, with the University of Southern California among many academic institutions. The district is a fruit-growing area, much of the produce passing through the port.

Loudspeaker This is a device which converts the varying electric current in the output of an amplifier into a sound wave. It is the opposite of a microphone which converts sound into a varying electric current (see Microphone). The most common type of loudspeaker is the *moving coil* or *dynamic* type. The cone-shaped horn of this type is attached at its centre to a cardboard cylinder around which is wound a coil of wire. The cylinder and coil are free to move in a powerful magnetic field supplied by a permanent magnet or an electromagnet.

The output current from the amplifier flows through the coil. It sets up a magnetic field around the coil (see Electricity) which interacts with the powerful magnetic field from the magnet, and the coil is either pulled further into the space between the poles of the magnet or moves outward depending upon the direction and strength of the current. In this way the variations in the current are converted into rapid to and fro movements of the coil. This vibrates the horn producing the desired sound wave.

A cut-away diagram of a loudspeaker.



The Moving Coil or Dynamic Loudspeaker

Louis XIV (1638-1715) was king of France for 72 years. He reigned longer than any other monarch in European history, and was called the *Sun King*. Louis became king at the age of four. His mother ruled for him until he was 23. He had complete power over France and its people.

Louis both aided and hurt France. Through his able ministers, such as Cardinal Mazarin, he at first gave France a more prosperous economy. He encouraged painters and writers, and founded the Academy of Sciences.

Louis wanted to extend France's in-

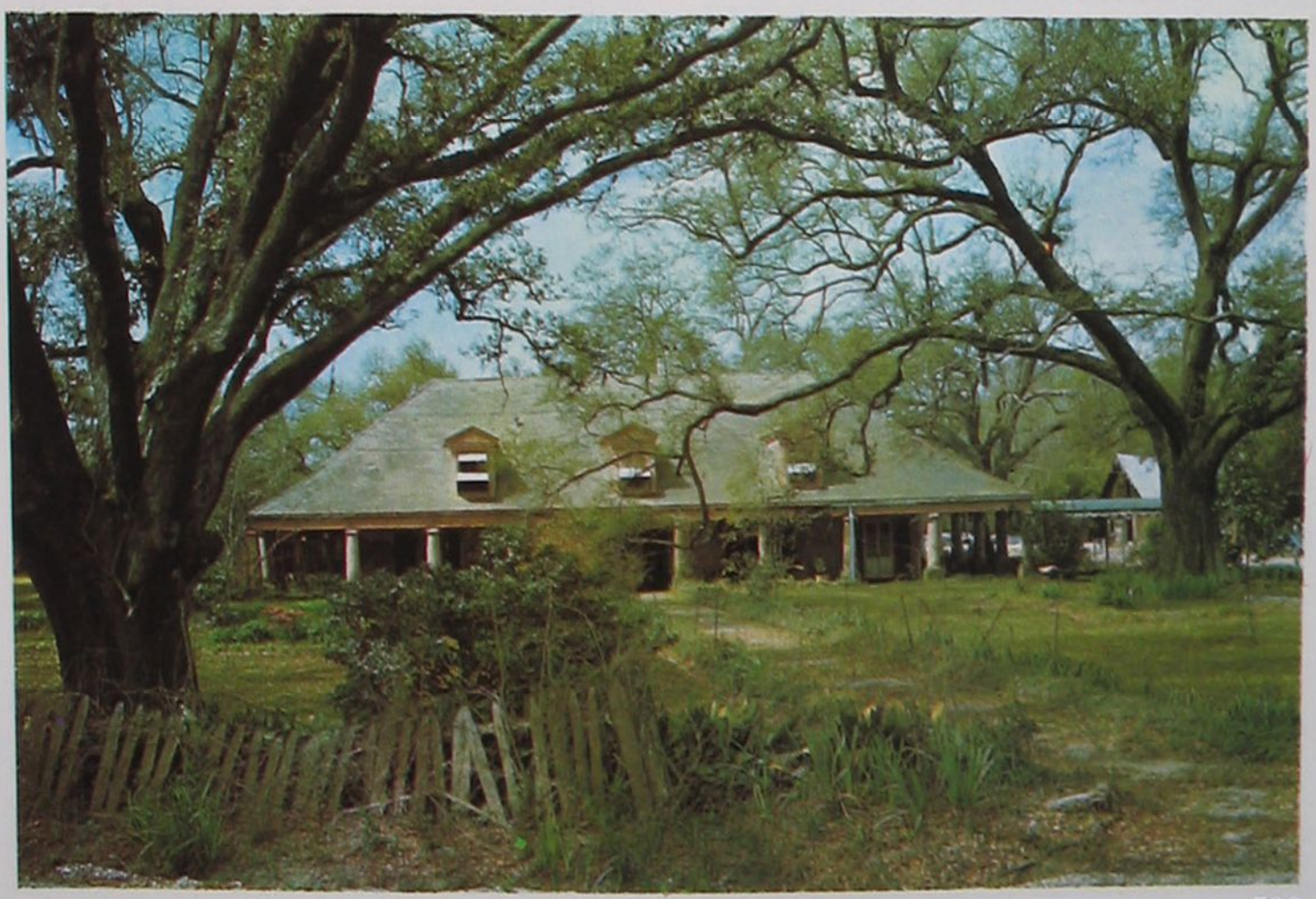
fluence through Europe. He led his country into four major wars. These wars resulted in debts the country could not afford. The luxurious life at the king's court also added to France's financial difficulties. Louis built a magnificent palace for himself at Versailles, near Paris. He required his chief nobles to live there with him so that he could control them more easily.

Louisiana, a U.S. state on the Gulf of Mexico, is part of the Deep South. It has an area of 48,523 square miles and a population of 3,643,000, of whom about a third are black. The state capital is Baton Rouge, but the leading city is historic New Orleans, a port that attracts many tourists.

Louisiana is largely fertile delta land, created by the gradual depositing of mud by the Mississippi. Flooding has been reduced by the building of *levees* (earth em-

Left: A portrait of Louis XIV. His reign (1643-1715) was the longest of any monarch in European history.

Below: An old plantation house in Louisiana.

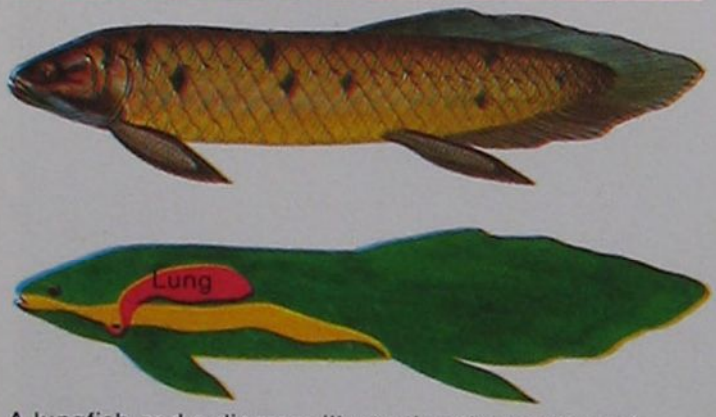


Location map of Louisiana.

bankments) and by the deepening of *bayous* (slow-moving streams). Cotton and rice are grown. Forests yield lumber and pulp for making paper. A third of the state's income is from oil and natural gas. There are also large chemical and food-processing industries.

The French explorer, La Salle, claimed the territory for France in 1682. It was sold to the U.S. in 1803, and in 1812 Louisiana became a state. Before the Civil War, the state grew rich on cotton produced by slave labour, and the steamer trade on the Mississippi.

Lungfishes are rather strange fishes which have lungs as well as gills. They can breathe air as well as water, and, in fact, they will drown if kept right under water. There are three kinds of lungfishes alive today, and they all live in muddy rivers and backwaters in tropical regions. The lungfishes come to the surface to gulp air into their lungs. This means that they can live in foul water, where other fish would soon die from lack of oxygen. The air breathing habit also allows the lungfishes to live in rivers which dry up in the dry season.



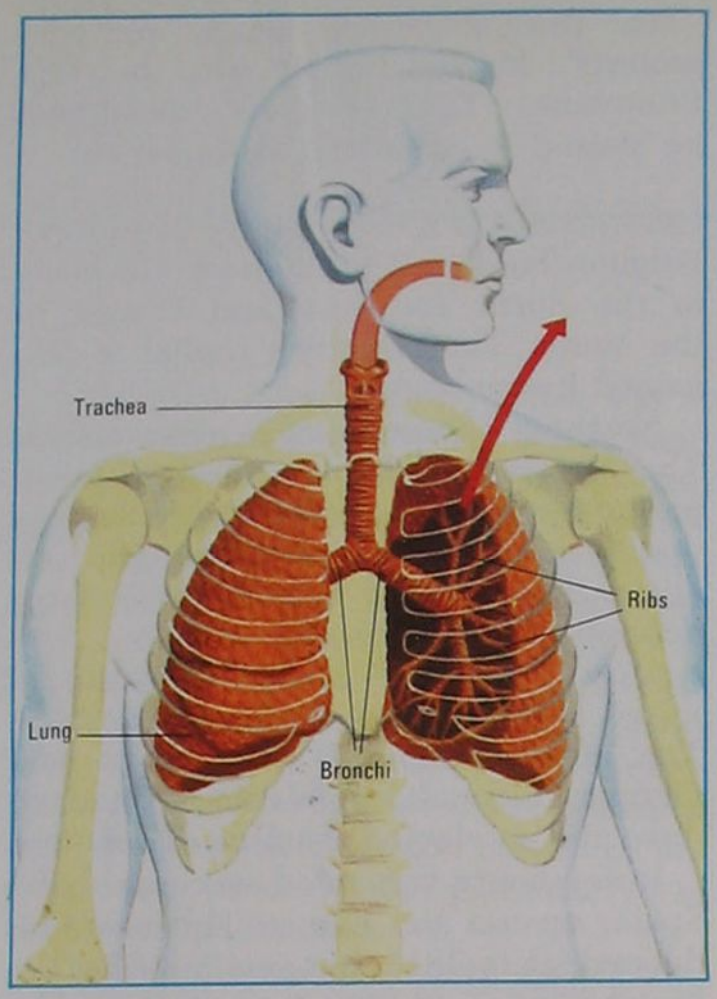
A lungfish and a diagram illustrating the position of the lung in the fish's body.

The African lungfish buries itself in the mud of the dry river bed and coils up in a cavity. It forms a tough cocoon, or shell, of mucus to line the cavity and to keep in the moisture. The cocoon has a small hole just over the lungfish's snout to enable it to breathe. The fish stays in the cocoon for up to about eight months, until the rains come, and lives on reserves of fat or muscle in its body. This condition is called *aestivation*.

The South American lungfish resembles the African lungfish in several ways. They are both about three to four feet long and have whip-like fins behind the head. But the South American lungfish does not form a cocoon when it aestivates. The Australian lungfish has paddle-shaped fins behind the head. It cannot live for long out of water and dies if the river bed dries completely.

Lungs are the organs by which amphibians, reptiles, birds and mammals breathe (see Breathing). There are usually two lungs, although snakes have room for only one fully developed lung in their slender bodies. The mammalian lungs almost fill the chest cavity, which is separated from the other internal organs by the *diaphragm*.

The job of the lungs is to absorb oxygen from the air and to get rid of carbon dioxide. To carry out this job efficiently, the internal surface of the lungs must be large. Amphibian lungs have a few ridges and pits on the inside but they are not very efficient. Amphibians get a lot of their oxygen through the skin and the lining of the mouth. Reptile lungs are more complicated and have a greater surface area. Mammalian lungs are the most complex of all, forming sponge-like structures.



Bird lungs are rather special because of the development of air-sacs (see Bird).

The total internal surface of a man's lungs is as big as that of a tennis court. This is because the lungs are composed of millions of tiny cup-shaped air cells called *alveoli*. These alveoli have extremely thin walls that are criss-crossed by tiny bloodvessels *(capillaries)*. Oxygen passes from the air-sacs into the bloodstream and carbon dioxide passes in the opposite direction. The air-sacs are connected with tiny tubes called *bronchioles* which all join together to form the *bronchus* of each lung. The two bronchi join together to form the *trachea*, or windpipe, which leads to the throat.

When we expand our chest cavities, air rushes down to the lungs, carrying fresh oxygen to the air-sacs. When we breathe out, we push air out of the lungs and it takes with it the carbon dioxide removed from the bloodstream.

The inside of the lungs of a new born baby are pink in colour. Adults who smoke or who live in polluted cities have lungs of mottled slate colour. Doctors are now agreed that cigarette smoking greatly increases the probability of a person developing a lung disease. Lung cancer is linked directly to smoking, and other diseases such as bronchitis are made worse by smoking.

Luther, Martin (1483-1546), was an important religious leader who lived in Germany in the late fifteenth and early sixteenth centuries.

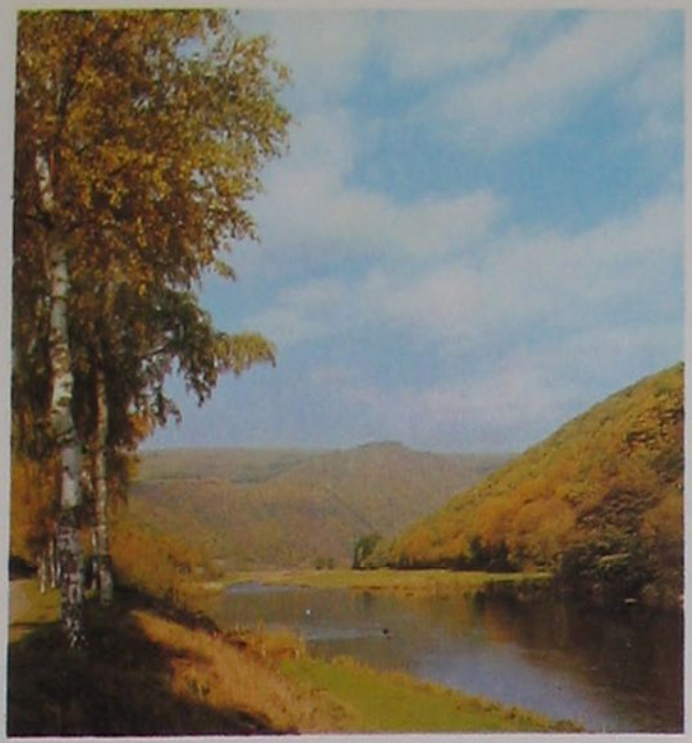
At that time, Catholicism was the only Christian religion. Luther was a priest. He spent many years studying the Bible and came to believe that the Catholic interpretation of the teachings of Jesus was not entirely correct.

He stated his beliefs in ninety-five theses, which he nailed to the door of a church in Wittenberg, the town where he lived. The Pope issued a *bull* (letter) condemning his views. When Luther received his copy he burned it in public.

Luther was now ordered to appear before a Diet (gathering) of German princes, nobles, and clergymen in the town of Worms. He was asked to take back what he had said. He refused, and the Diet of Worms condemned him as a *heretic* (non-believer).

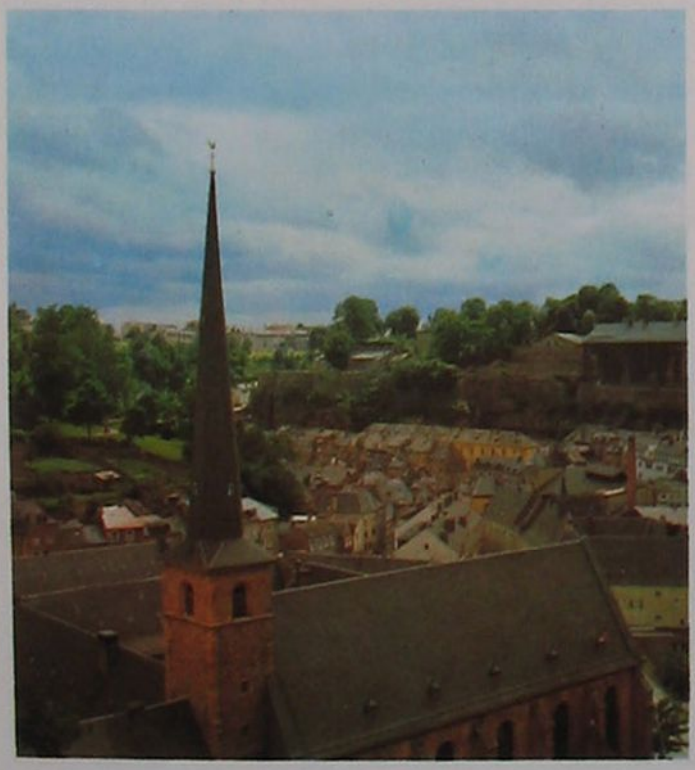
For the next ten months he lived in retreat in the castle of one of his protectors. But news reached him of changes taking place in Wittenberg. Fearing that without his leadership the religious movement he had started might go astray, he returned there to organize the new church.

Martin Luther (left) was a priest who challenged the teaching of the Roman Catholic Church in the 16th century and so began a wide movement of change known as the Reformation. He was put on trial for his beliefs and concluded his defence with the now famous words: 'Here I stand, I can do no other.'



Facts and Figures
Area: 998 square miles.
Population: 339,000.
Capital: Luxembourg.

Picturesque, huddled villages (below) and beautiful scenery such as the wooded valley of the Moselle (above) make up one face of Luxembourg. The other is the steel industry which provides most of the country's wealth. The map (right) shows the position of Luxembourg.



The word *Protestant* means 'one who protests'. Martin Luther was the first Protestant. The religious movement he started is called the Reformation.

Luxembourg is a tiny country in Europe. Belgium borders it to the west, Germany to the north and east, and France to the south. The country's capital is also named Luxembourg.

Northern Luxembourg is mountainous. The rest is a high plain. Forests cover part of the country. Most of Luxembourg's wealth comes from its iron and steel industry based upon the country's large deposits of iron ore.

Most people in Luxembourg are of mixed Dutch, French or German descent. The official languages are French and German. Luxembourg is ruled by a grand duke and an elected chamber of deputies.

Luxembourg was ruled successively by Spain, Austria and France. It became independent in 1815, but was ruled by the Dutch kings until 1890. It was occupied by the Germans in both wars. It is a member of the European Common Market.

Lynx is a medium-sized member of the cat family. It has beautiful grey or beige fur with black markings, a short tail and long, pointed ears with fur tufts on the ends. Lynxes are becoming rarer, but can still be found in the colder parts of North America, in Scandinavia, Spain and Siberia. Hunting mostly at night, they kill small animals such as hares. Lynxes are good tree climbers and with their broad pads can run swiftly over snow.

Lyons is a city in south-eastern France, situated where the Rhône and Sâone rivers meet. With 535,000 people, it is the country's third largest city. Its once important silk industry, dating from the 15th century, has largely given way to man-made textiles. Chemicals, lorries, electrical equipment, clothing and books are also produced. The Romans founded the city in 43 B.C.

M

Machiavelli, Niccolò (1469-1527), was an Italian statesman and writer whose name has long been thought of as symbolizing all that is sinister in politics and statesmanship. In the literature of Shakespeare's time, many references associate him with the Devil. These suggestions of evil derive mainly from Machiavelli's political work *The Prince*, but many historians regard them as unjust. Nevertheless, the word *Machiavellian* has come into the English language, meaning cunning and underhand, particularly in relation to politicians.

Machiavelli was born into an old and respected Florentine family, and educated mostly by private tutors. In 1498, when the Medicis, the ruling family of Florence, were driven out of the city by an invasion from France, Machiavelli became a high official in the new government. But he was dismissed from office in 1512, when they returned to power. The following year he was accused of plotting with others of their enemies to overthrow them. He was arrested, tortured, and thrown into prison.

Left: Machiavelli set down his thoughts on political affairs with such frankness that he came to be regarded as an arch-schemer and ruthless cynic.

He was later released, and spent the last years of his life writing. His main works concerned politics and history, but he also wrote poetry and comedies.

Machinery Machines are essential to every sphere of human activity. They have taken much of the hard work out of our lives and have given us more leisure.

Machines such as the petrol engine and steam turbine are called *prime movers* because they convert energy directly into mechanical power. Other machines are driven by prime movers.

Today most goods are produced cheaply and in large quantities by machines. No longer do we have to rely on, and pay dearly for the small output of a few skilled craftsmen. And the real key to such *mass production* is that the machines make *identical* parts. Any one part will always fit into another. This means that assembly can be rapid and often automatic. And the products are therefore cheaper.

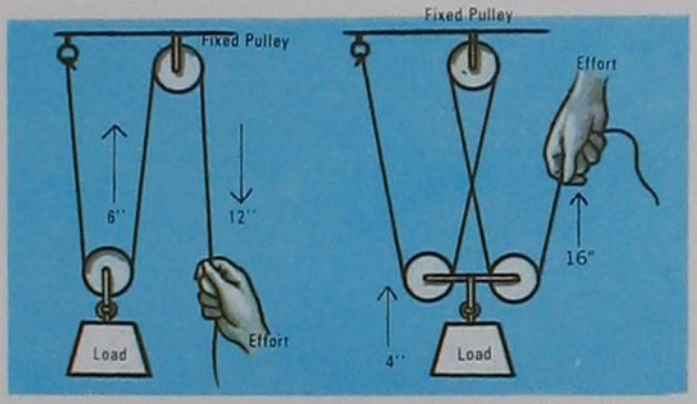
Right: Machines are replacing human labour in virtually every field of work. Milking machines, for instance, are far more efficient and hygienic than hand-milking.

Now we have machines like the computer which are taking over the control of other machines and replacing even the human operators. This *automation* is already widespread in the chemical industry. (See Automation.)

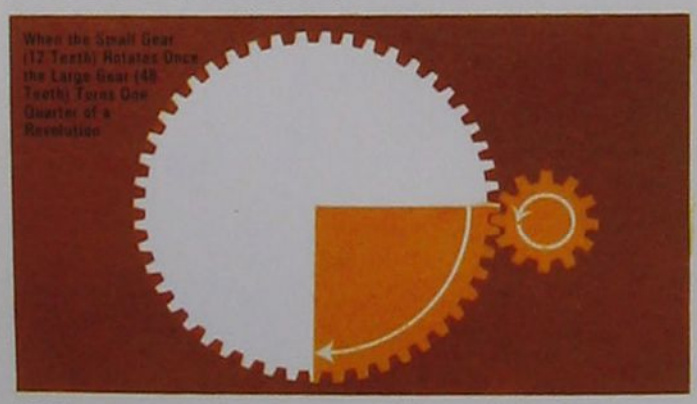
Machines were first used on a large scale in the spinning industry. Richard Arkwright in Britain pioneered the factory method of production in about 1770 when he installed several of his power looms in a special building. The American inventor Eli Whitney first showed the advantages of mass production in 1800, making muskets with standardized parts.

Machines, simple Any device that can do work is called a machine. We normally think of machines as complicated devices, but some are so simple that we seldom realize that they are machines at all.

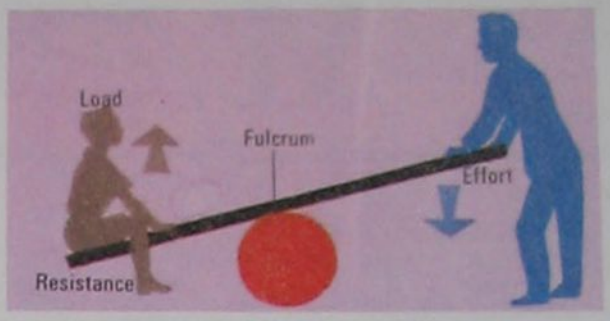
The three simplest machines are the *lever*, the *inclined plane* and the *wheel*. Other simple machines are based on these three types. The *pulley* and the *wheel and axle* are different forms of lever. The *wedge* and the *screw* are forms of inclined plane.



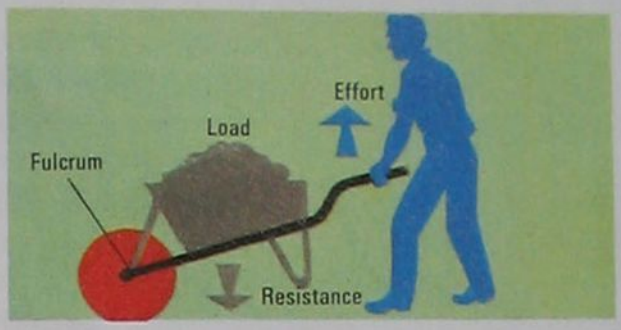
Above: Pulleys reduce the effort needed to lift loads. If the effort needed is half the weight of the load (left) the load moves half the distance of the effort. If the effort needed is one-fourth of the load (right) the load moves one-fourth as far as the effort.
Below: Gears enable a given effort to move a large load slowly or a small load quickly.



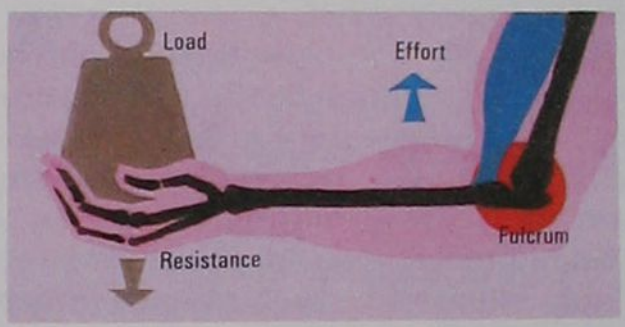
THE ORDERS OF LEVERS



First order lever. The fulcrum (pivot) is between the resistance (load) and the effort.



Second order lever. The resistance is between the fulcrum and the effort.



Third order lever. The effort is between the resistance and the fulcrum. This kind of lever has no advantage—in fact a greater effort is needed than the resistance moved.

To do work, we must exert a certain force over a certain distance. The greater the distance the more work we can do with our effort. The simple machines are merely devices which increase the distance over which we apply our effort.

For example, with a lever such as a crowbar, we can lift a heavy load on one end a little way by pushing down the other end a long way. Pushing a heavy load a long way up an inclined plane, or

slope, takes less effort than lifting it vertically by the same amount.

Mackenzie River is the longest river in Canada. It runs 1,120 miles through the Northwest Territories, rising in the Great Bear Lake and emptying into the Arctic Ocean. The river is broad, and open to shipping when ice-free—that is, from June to October.

The valley is largely forested. Trappers catch muskrats and other fur-bearing animals. The petroleum industry began after oil was discovered at Norman Wells in 1920. Since then, other reserves of natural gas, radium and uranium have been found. Sir Alexander Mackenzie, after whom the river was named, first explored it in 1789. By 1810 trading posts were set up along its length.

The Mackenzie is fed by a number of tributaries, including the Finlay, Peace and Slave rivers, which form a continuous system—known as the Mackenzie river system—over 2,500 miles long. It is second only, in North America, to the Mississippi-Missouri system.

McKinley, Mt. is the highest mountain on the continent of North America. The North Peak towers 20,320 feet above sea level, the South Peak is slightly lower (19,470 feet). The mountain is located in Alaska's Mount McKinley National Park. It belongs to the Alaska Range. Most of Mt. McKinley is permanently covered in snow. Two American climbers, Archdeacon Hudson Stock and Harry P. Karsten, were the first people to reach its summit, in 1913. Before this, several other people had falsely claimed success. The Indians of the region called the mountain *Denali*, meaning *tall one*. It was later named after William McKinley, the president of the United States.

Location map of Madagascar.

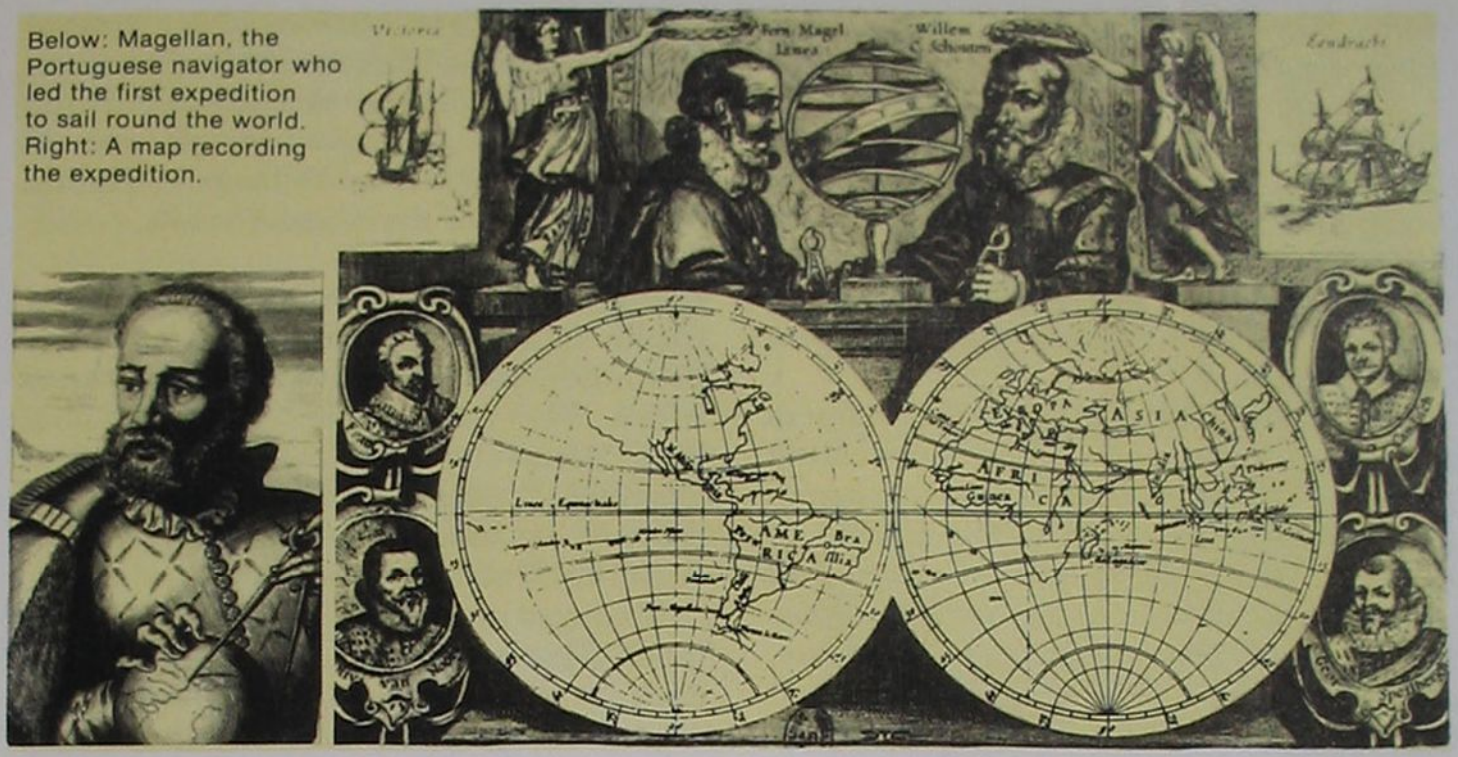
Madagascar is the world's fourth largest island. It lies in the Indian Ocean, about 250 miles from the south-eastern coast of Africa. The body of water separating it from Africa is called the Mozambique Channel. Madagascar is an independent country. Its official name is the Malagasy Republic. Tananarive is its capital city.

Madagascar's area is 230,035 square miles. The land is low along the coasts. It rises to highlands in the interior. The climate is generally hot. There is more moisture and better soil in coastal areas.

The island's 6,600,000 people belong to various groups. The most numerous are the Merina, or Hova, peoples who live in the central highlands. They came to the island from Indonesia about 2,000 years ago. Other groups of people are of Negro or Arab descent. Some Chinese and Indian traders live there. Most of Madagascar's people live by farming. They grow coffee, vanilla, cloves, rice and sugar. There are more cattle on the island than there are people—about 8 million.

The Arabs established colonies in Madagascar during the Middle Ages. France colonized the island in the late 1800's and French is still one of the official languages. The independent Malagasy Republic was established in 1960.

Madrid (pop. 3,150,000) is the capital city of Spain and of the province of Madrid. It is situated in the centre of the country on the River Manzanares on a high plateau 2,150 feet above sea level, and is the highest capital city in Europe. The city originated in the tenth century as a small Moorish fortress, and became the capital in 1561 when Philip II removed the seat of government from Toledo. It is an administrative and commercial centre, but its



Below: Magellan, the Portuguese navigator who led the first expedition to sail round the world. Right: A map recording the expedition.

industrial importance is second to that of Barcelona. Modern wide avenues and squares contrast strongly with the narrow cobbled alleys of the old town.

Magellan, Ferdinand (1480?-1521), was a Portuguese navigator who led the first expedition to sail round the world. Magellan believed that he could find a route to the South Seas (the Pacific Ocean) by going through or round South America. King Charles V of Spain agreed to provide him with five ships, about 260 men, and enough food for two years.

They set sail from Seville in September, 1519. After following the coast of South America, they spent the winter in southern Argentina, where Magellan put down a mutiny. In October, 1520, they found the strait that links the Atlantic and Pacific, now known as the Strait of Magellan.

The ocean Magellan sailed into was so calm that he called it the Pacific (which means peaceful). One of his ships, the *Santiago* had been wrecked, and the *San Antonio*, carrying most of their food, had deserted them. So with his three remaining ships, Magellan sailed westwards. After a terrible voyage during which many men died of starvation and disease, the expedition eventually reached the Philippines. There, on the 27th April, 1521, Magellan was killed by an island chief.

The *Victoria*, the only ship to complete the voyage, reached Seville in September, 1522, with 18 men on board.

Magic and magicians. Magic is an attempt to control events with the aid of spirits or other supernatural beings. Magicians use *spells* in order to make these supposed beings carry out their wishes.

Prehistoric peoples did not understand why the seasons changed, or why their crops succeeded or failed. They did not know why people were born or why they died. They believed that magical spirits were responsible for these events, and for all the other events of their lives. They tried to influence the spirits to make only favourable events happen. In primitive societies today, people still think in this way.

The person whose main job it is to win the favour of the spirits, is the magician or witch doctor. He performs ceremonies and casts spells of various kinds. He tries to ward off evil spirits and attract friendly ones. During the Middle Ages, most people believed in some kind of magic. People called *alchemists* tried to use

Right: Witches have long been thought to have magical powers. In this 17th-century painting, called The Witches' Sabbath, magical rites are used to summon demons and devils.

magic to change lead and other cheap metals into gold. Many people became afraid of magic. They associated it with the devil. They burned people at the stake for practising witchcraft.

Remnants of magic survive even in modern civilization. One remnant is *superstition*. An example of superstition is the belief some people have that breaking a mirror will bring seven years' bad luck. Others think a black cat is a bad sign.

Astrology is another kind of magical belief still held today. Astrology is the

belief that the planets and other heavenly bodies influence human life. Astrologers treat astrology as a serious science and make complicated calculations and charts based on the position of the stars at the exact time of a person's birth to foretell what his future is likely to be.

Magna Carta, or the Great Charter, was sealed by King John of England on the Thames island of Runnymede, near Windsor, on 15th June, 1215. John had tried to strengthen the king's power. He was hard-working and clever, but untrustworthy. He cheated his barons of their rights, taxed his people heavily, and quarrelled with the Pope. The barons rebelled in 1215, seized London and made a list of their complaints. Archbishop Langton of Canterbury persuaded John to agree to the barons' demands. A set of rules which John promised to keep was written down in Latin on parchment. This document is called Magna Carta. Copies were made to be read out by the sheriffs of different counties.

Most of Magna Carta concerned the rights of barons. Some of it was of importance to everyone; in particular every man was promised justice. Magna Carta was rewritten on John's death in 1216, and again in 1217 and 1225. English lawyers still refer to Magna Carta, for it is regarded as the beginning of English constitutional law. It showed that even the king must keep the laws of the land and it set limits to his power. In later times, when kings or governments acted unfairly, people pointed to Magna Carta, claiming new rights in its name. It is one of the great documents of human freedom and has done much to shape the way people in Britain, the Commonwealth and the U.S.A. are ruled today.

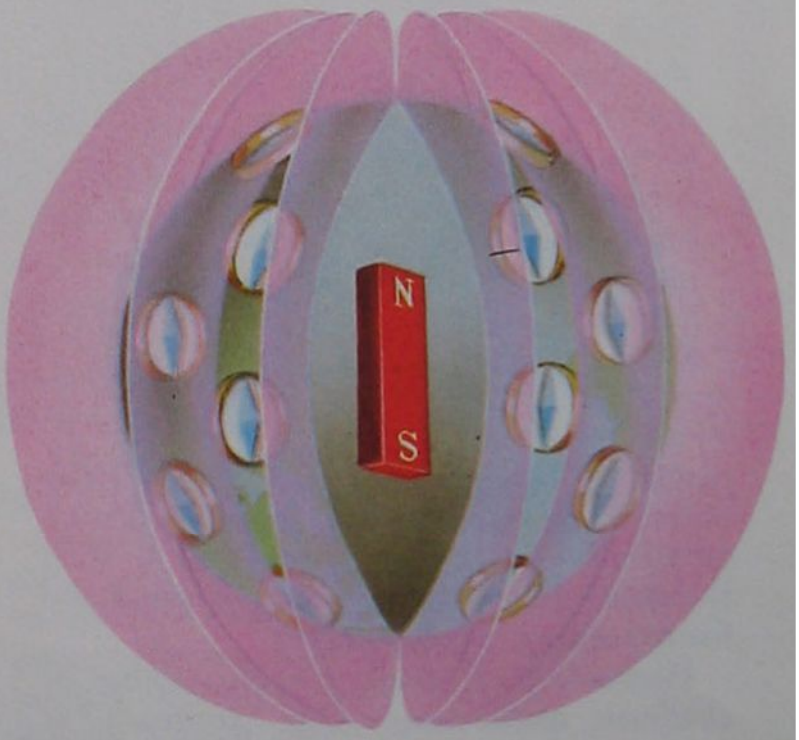
Magnesium is a structural metal that is even lighter than aluminium. It is normally used in alloys with such metals as aluminium, zinc, manganese, and zirconium, which make it harder and stronger. Being so light, magnesium alloys are widely used for aircraft parts.

Magnesium burns in air with a brilliant white flame. In powder form it is used in flares and fireworks. But it can be melted, cast, and machined easily and safely. Magnesium is a very common metal in the Earth's crust. Two common ores are dolomite and magnesite. The metal can also be extracted from sea water.

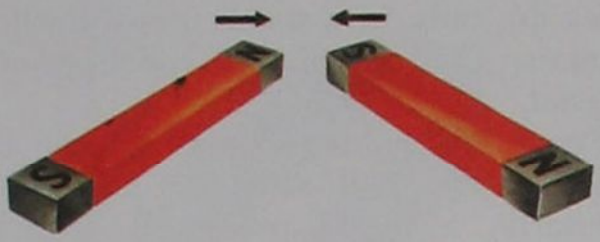
Magnetic poles These are the points on the Earth's surface towards which a compass needle points. The metallic interior of the Earth acts as a giant magnet, producing a magnetic field over the entire globe. The north and south poles of this field are situated near the geographic or true North and South Poles. The true poles are the ends of the axis about which the Earth rotates.

The magnetic poles move in relation to the true poles, as the Earth's magnetic field shifts. At present, the north magnetic pole is in the islands of northern Canada, a thousand miles from the North Pole. The south magnetic pole is near the coast

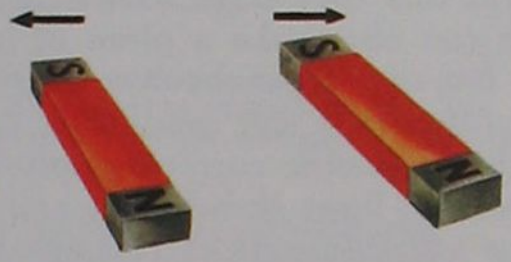
The Earth acts as though it contained a vast bar magnet. One end of a compass needle will always come to rest pointing to the Earth's magnetic north pole.



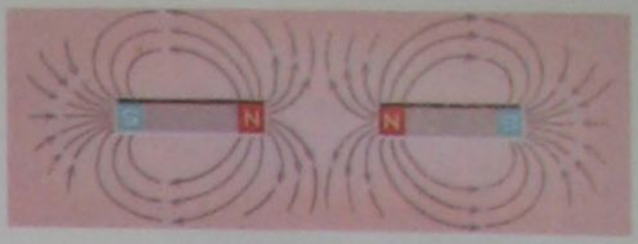
Every magnet has two poles, a north and a south.



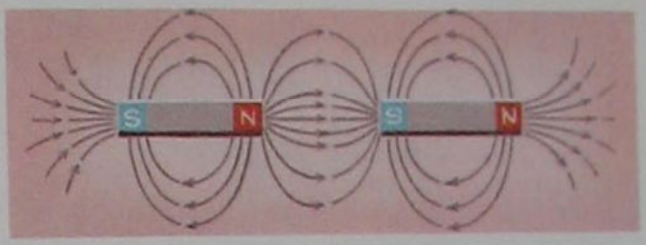
The unlike poles of two magnets attract each other.



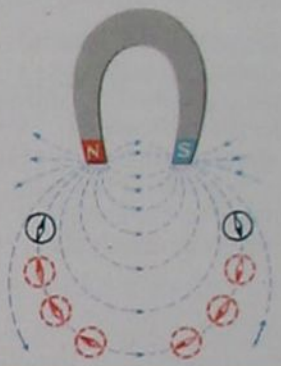
The like poles of two magnets repel each other.



Every magnet has a magnetic field passing through it and surrounding it. The lines of force are the paths that would be followed by a small north pole if it were free to move in a magnetic field. Two arrangements of magnets are shown above and below.



Right: A small compass can be used to trace out such a line of force (in this case with a horse-shoe magnet). The small north pole would start at the north pole of the magnet and be attracted across to the south pole.



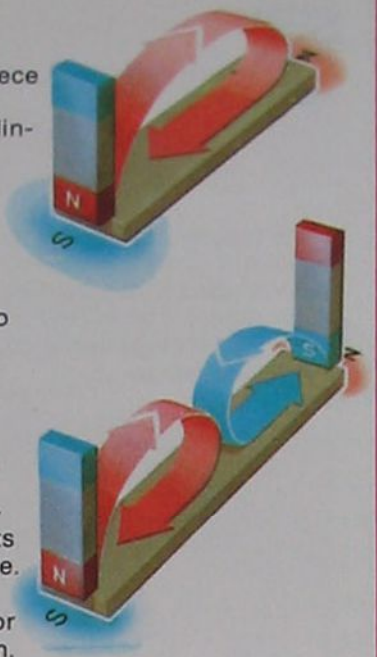
of Antarctica, about 1,500 miles from the South Pole. Thus a compass needle does not point exactly north or south, but varies by an angle called the *declination*. The declination changes from place to place, and from year to year. But, with the aid of declination charts, accurate navigation can be made with a compass.

Magnetism owes its name to the fact that the early Greeks found the natural magnetic material called lodestone in an area called Magnesia. Lodestone, like the man-made magnets we are familiar with today, has several very interesting properties. For one thing it will, as the Greeks discovered, attract pieces of iron. The Romans were also aware that it will on occasions repel iron as well as attracting it.

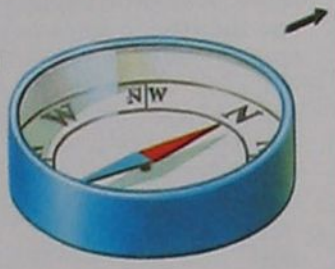
What neither the Greeks nor the Romans seemed to have discovered is that the lodestone always points towards the North Pole of the Earth and so can be used by ships to find their way about when they are out of sight of land.

The first recorded reference to the use of the magnet as a means of finding direction seems to have been made by the Chinese mathematician and instrument-maker, Shen Kua, who lived about the time of the Norman Conquest of Britain. Shortly after this, Muslim traders are known to have used a magnetic compass to find their way on voyages between Canton and Sumatra. Because of this, the Muslims are usually credited with being the first to use the magnetic compass at sea.

It was many centuries later before a proper understanding of the nature of magnetism was obtained. Indeed, it is probably true to say that scientists are still finding out fresh facts about it. It



Each molecule in a piece of iron is like a tiny magnet. But in an ordinary bar of iron the molecules lie in many different directions and their effects tend to cancel out. A bar of iron can, however, be made into a weak magnet by repeatedly stroking it with one end of a magnet. The stroking must always be in the same direction. This has the effect of dragging the small magnets inside the iron into line. The stroking may be done with either one or two magnets as shown.



A compass needle is simply a small bar magnet which is allowed to swing freely. It always comes to rest with one end pointing towards the Earth's magnetic north pole.

is known now that materials owe their magnetism to the way in which the electrons of their atoms are arranged. In some materials, such as lodestone, iron and steel, the arrangements of the electrons are such that the individual molecules of the material are each a tiny magnet. At one end of each molecule there is what is known as a north-seeking pole; at the other end there is a south-seeking pole. If it were possible to pivot the molecule so that it could revolve, it would be found that the molecule would come to rest with its north-seeking (or north) pole pointing towards the North Pole of the Earth.

In a natural piece of iron, the individual molecules lie in many different directions and the bar of iron itself does not point in any particular direction, because some of its molecules are trying to pull in one direction and some in another.

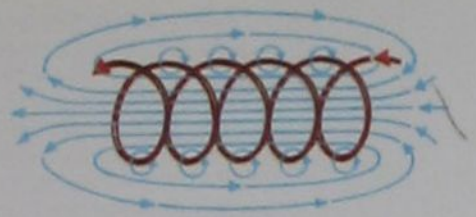
To convert the bar of iron into a compass needle we need only stroke the south pole of an existing magnet along its length. As it moves along, the south pole will cause the north poles of all the molecules to swing round and point towards it. By the time it reaches the far end of the bar, all the molecules will be pointing in the same direction. The whole bar will now act as the individual molecules do, only in a much more powerful manner. The bar of iron has become a magnet.

From this behaviour we can see that a south pole will attract a north pole. Similarly, a north pole will attract a south pole. However, if we place two south poles or two north poles together we find that they repel each other.

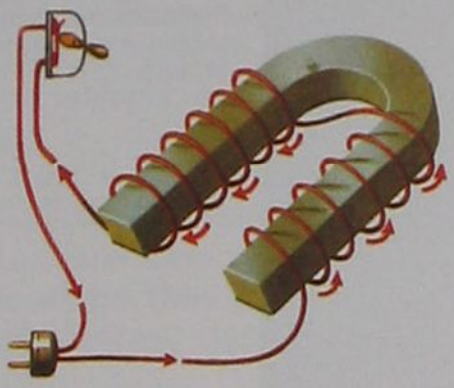
We can also make a piece of iron or steel into a magnet by wrapping a coil of wire round it and connecting the coil to a direct electric current supply. When the current flows through the coil it will set up a magnetic field, just like that of a real magnet, and this will pull the molecules into line.

In some magnetic materials the molecules are very easy to move; in others they move only with the greatest of difficulty. The latter type are used for *permanent* magnets. The former type are very useful because they can be used in what are called *electromagnets*. These magnets become operational when an electric current flows through a coil wound round them. When the current is switched off, however, they immediately lose their magnetism. This is convenient in cranes moving steel, for example, and for electric doorbells.

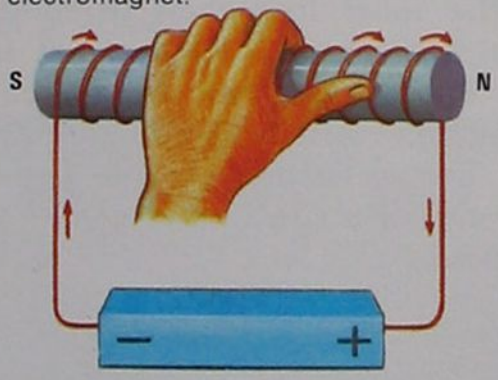
The fact that a compass needle will always point towards the North Pole of the Earth, and that north and south magnetic poles attract each other, makes it clear that the Earth must somehow behave like a magnet. This, in fact, is so. Very roughly, the Earth acts as though it has a bar magnet through its centre with the south pole near the Earth's



When an electric current is passed through a coil of wire, the coil behaves just like a bar magnet.



The strength of the magnetic field of a coil of wire is increased by putting a soft iron core inside it. Coil and core are together known as an electromagnet.



There is a simple way of telling which is the north pole of an electromagnet. If the coil is grasped by the left hand so that the fingers point in the direction of the electron flow (negative to positive) the thumb points towards the north pole.

North Pole and its north pole near the Earth's South Pole. The point to which the compass needle points is, however, slightly to one side of the true, or geographic, North Pole, and its position drifts slightly each year. To find the true direction of the North Pole we must add or subtract a correcting factor to allow for this displacement (see Magnetic poles).

The magnetic field of the Earth spreads out into space for thousands of miles. It traps particles from the Sun, which form electrically-charged belts around the Earth known as the Van Allen Belts. The magnetic field also attracts other types of particles towards the North and South Poles where they produce the coloured displays in the sky known as aurorae (see Aurora).

Talking points

*Take a piece of iron and stroke it with one pole of a permanent magnet. You will find that the piece of iron becomes a magnet itself. Explain in your own words what has taken place and why.

*If you take an iron tube and wrap wire around it and then connect the two ends of the wire to the terminals of an electric battery, the iron tube will become magnetized. How does the electric current achieve this?

*How many everyday uses for magnets can you think of?

Articles to read

Aurora; Compass; Electromagnetic radiation; Magnetic poles.

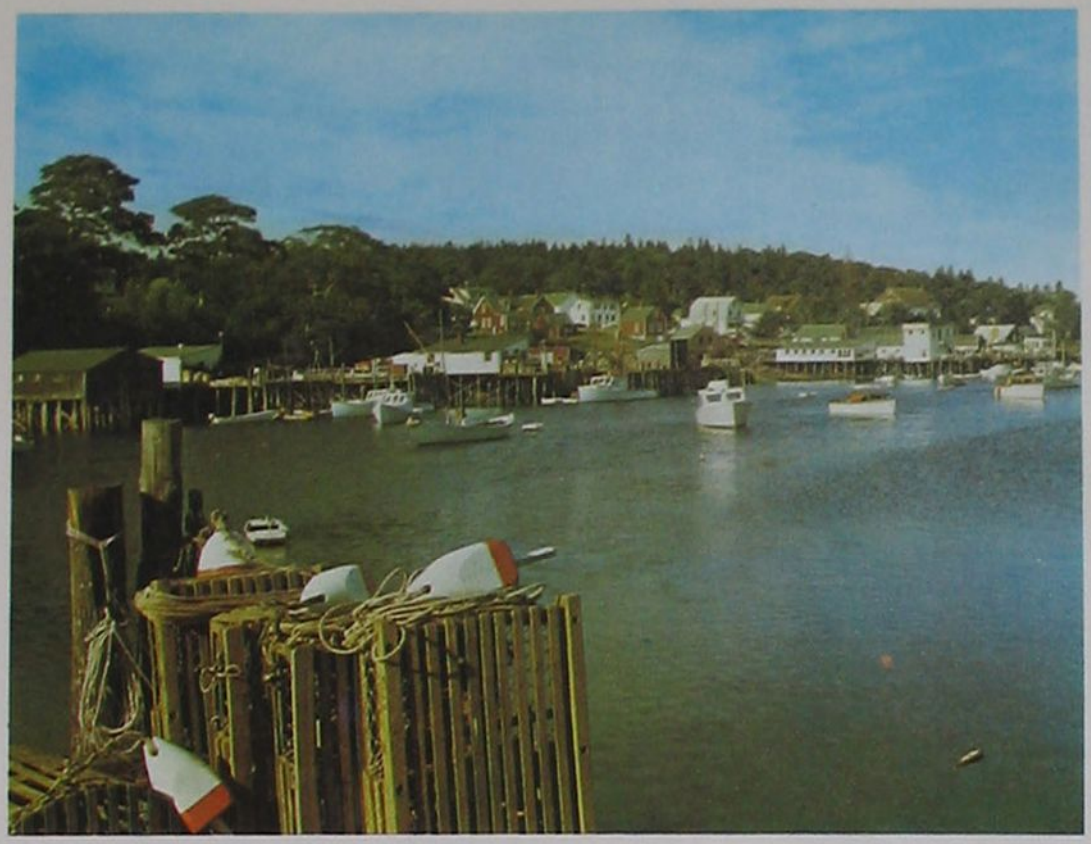
Maine is a New England state lying at the extreme north-east tip of the United States. Known for its beautiful scenery—including a rugged Atlantic coastline, forest-covered mountains and numerous lakes and streams—it attracts large numbers of tourists, campers and sports enthusiasts every year. These provide needed revenue for the state's economy.

Maine covers an area of 33,215 square miles, and has a population of 992,000. Augusta is the state capital, but Portland is the largest city and chief industrial centre.

The important wood-processing industry uses timber from the state's great fir and spruce forests to make paper and other products. Other major industries include the production of shoes, textiles and food products.

Maine's coastal waters are fished for

Location map of Maine.



New Harbor, Maine. Fishing boats and pleasure craft lie side by side in this small New England port. The Maine coastline has many small towns such as this one. They attract holiday-makers from Canada. Maine also has an important fishing industry. It is one of the major lobster fishing areas of the world. Lobster 'pots' with floats attached to them are shown in the left foreground.

lobsters, sardines and other catches. Sardines are canned in the state. Farming is important, despite poor soil. Potatoes are the chief crop. Grass for hay, apples and blueberries are also grown. Poultry farming has increased since World War II.

The explorer John Cabot is believed to have explored the region in the 1490's. English settlers arrived in 1607. From 1677 until it became a separate state in 1820, Maine was governed as part of Massachusetts.

Malacca is a small Malaysian state on the west coast of the Malay Peninsula. It has 404,000 people, most of whom live in small villages and work as farmers. They grow rice and coconuts and tend rubber trees on plantations or small estates. The land is generally low. It was once covered with dense jungle. Chinese make up more than half the population. The rest are Malays and Indians.

Malacca is also the name of the state's capital and only town. Founded in the early 1400's by a Sumatran prince, it soon became the centre of a powerful Muslim empire, ruled by sultans. Its port became the most important in south-east Asia until Singapore displaced it in the 1800's. The Portuguese and Dutch conquered Malacca in 1511 and 1641 respectively. Britain acquired the region in 1824 and made it a colony in the Straits Settlements.

Malaria is a serious disease that affects people in the warmer regions of the world. It is commonest in central Africa, South-east Asia, Central America, and around the Mediterranean Sea.

A person with malaria becomes extremely weak. He alternates between bouts of high fever and sweating and bouts of chills and shivering. The symptoms of the disease may come back again months or even years afterwards.

Malaria is caused by a parasite called a *protozoan*. It is too small to be seen without a microscope. The disease is carried from person to person by the female *Anopheles* mosquito. When the mosquito bites an infected person, the protozoans develop in its body. Later, when the mosquito bites a healthy person, the parasites are injected into the blood-stream.

Doctors treat malaria with drugs. The oldest and best known of these is *quinine*. This is a bitter substance made from the bark of the cinchona tree. Quinine reduces the fever and other symptoms of malaria. But does not kill the parasites. If it is used for too long it can have unpleasant side effects.

During World War II, doctors developed synthetic (man-made) drugs to treat malaria. Among these are atabrine and chloroquine. These were effective in most cases. But it was discovered that some kinds of malaria parasites were resistant to them.

The best way of preventing malaria is to kill off the mosquitoes that carry the disease. Sanitation workers drain the swamps where they breed, and use insecticides to destroy them.

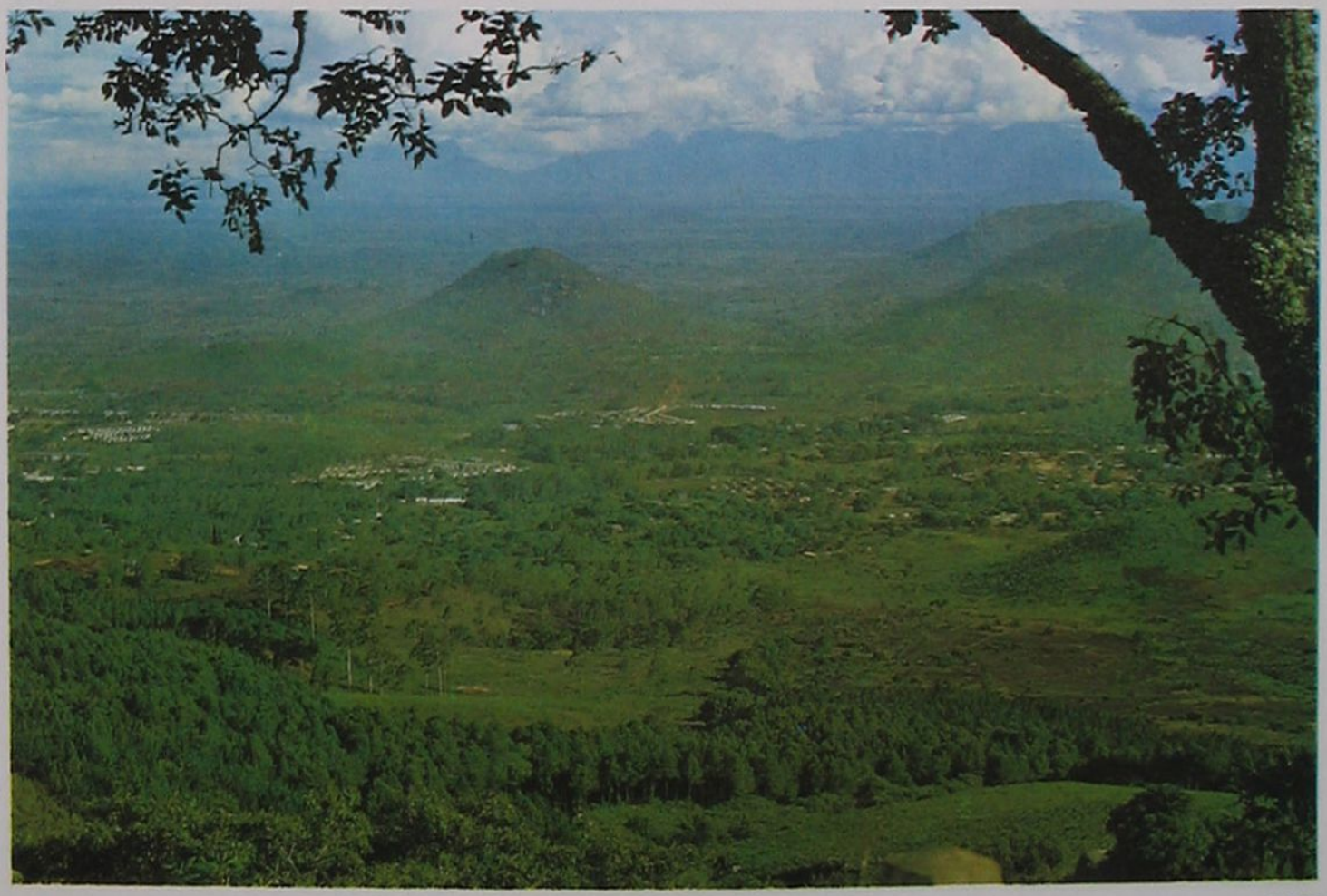
Malawi is a landlocked republic in south-eastern Africa. It is bordered by Tanzania, Mozambique and Zambia. The capital of Malawi is Zomba.

Malawi has an area of 46,000 square miles. It is a land of great beauty with high mountains, beautiful forests, and lakes. The largest of these is 360-mile-long Lake Malawi (also called Lake Nyasa). It runs along the country's eastern border. It lies in Africa's Great Rift Valley.

Most of Malawi's 4,530,000 people are Christians. They speak several languages, but the official languages are Nyanja and English. Most people farm for a living. They grow tea, tobacco, maize, cotton, rice and peanuts. Fish are caught in Lake Malawi. Malawi has large deposits of

Right: Location map of Malawi.

Below: A view of Zomba, the capital of Malawi. It is the centre of the tea and cotton growing area of the country.



minerals, such as bauxite (aluminium ore) and coal.

David Livingstone, the Scottish explorer and missionary, visited the area in 1859. It became a British protectorate in 1891. At that time it was called Nyasaland. Malawi became an independent country in 1964. The country has remained a member of the Commonwealth.

Malaya and Malays. Malaya, now known as *West Malaysia,* consists of 11 states at the southern end of the Malay Peninsula in south-east Asia. A former British colony, then an independent country for six years, it became part of the Federation of Malaysia in 1963. Since the days of British rule, Malaya has been a prosperous region, sending important natural resources to other parts of the world. Under the British, well-organized school, medical and administrative services were established.

Malaya lies south of Thailand and north of the small, independent state of Singapore, through which much of its trade passes. Sumatra lies to the west, across the Strait of Malacca, and the South China Sea separates Malaya from Borneo on the east. Malaya's total area is 50,700 square miles.

About half Malaya's nine million inhabitants are *Malays,* the native people of the region. They are believed to have come originally from southern China, as long ago as 2500 B.C. They are brown-skinned, dark-haired people of the Mongoloid race. Malays also live in Indonesia and the Philippines. Their language, called Malay, is one of the Malayo-Polynesian group. Since the 15th century Malays have practised the Muslim religion of Islam.

Some Malays work in government, but most are farmers and fisherman. They live in small villages and grow rice as their basic food. Tapioca, pineapples and bananas are also grown. The usual dress for both men and women is a sarong, a length of material wrapped round as a skirt, which the men wear over trousers and the women with a jacket.

Over a third of Malaya's population are Chinese who came as immigrants to work in mining and other industries, and as shopkeepers and traders. Most Chinese live in the towns – Kuala Lumpur, Malaysia's capital, Georgetown and Ipoh. A tenth of the population are Indians, especially Tamils from southern India. Many Tamils work in the rubber plantations. The rest of the population are aborigines, and other natives who live in the hills.

Mountains up to 7,000 feet high run the length of Malaya, and are covered with dense jungle, making the region difficult to cross. Settlements have grown up on the coastal lowlands, particularly in the west, where they are linked by roads and railways. Much of the land is swampy, so the houses are built on wooden stilts. Land for farming has been cleared of forests, and more land is being cleared all the time. Malaya is close to the Equator, and the climate is hot and damp. Heavy rains fall seasonally.

Rubber, grown on plantations since the 1870's, and tin, mined near the west coast, are the mainstays of the Malayan economy. Malaya leads the world in the production of both. Valuable timbers such as ebony, teak and sandalwood are also exported, as are palm oil, palm kernels and coconut products. Malaya has important deposits of iron, *bauxite* (aluminium ore) and gold. Although there is little industrial development in Malaya, efforts are being made to increase it.

Location map of Malaya (circled).

Above: A single storey bungalow in the town of Johore Bahru in Malaya. It is built up on brick piles to prevent flooding in the rainy season.

Right: A street vendor in a Malayan town sells wire bird traps to passers-by. Note that the advertisements on the wall in the background are written both in English and Chinese.

Various small states under Buddhist and Hindu rulers were established in Malaya for trading purposes before the 14th century. Then Arab traders from India arrived, attracted by the wealthy spice trade. They converted the population to the Muslim religion, and by the 15th century controlled the region through the sultan of Malacca.

Europeans reached the area in the 16th century and soon recognized the advantages of controlling all trade. The Portuguese took over Malacca in 1511, then the Dutch acquired it in 1641. The British East India Company leased Penang Island in 1786. In 1819 they founded Singapore and in 1824 acquired Malacca from the Dutch. These three holdings were combined into the Straits Settlements crown colony in 1867.

In 1895 Perak, Selangor, Negri Sembilan, and Pahang became the Federated Malay States, under British protection. In 1909 four more states—Kedah, Perlis, Kelantan, and Trengganu—were acquired from Siam. These, along with Johore, became the Unfederated Malay States.

Japan occupied Malaya during World War II. After the war, in 1948, Britain formed all the states into the Federation of Malaya. Britain faced guerrilla warfare from the Communists, and increasing pressure from independence movements. The Communists were defeated, but the nationalists finally achieved their aim when independence was granted in 1957. The Federation of Malaysia came into being in 1963.

Above: The modern parliament building in Kuala Lumpur.
Right: Location map of Malaysia.

Malaysia is a tropical country in southeast Asia. It is a member of the Commonwealth of Nations. Malaysia is a federation of 13 states, originally formed in 1963. The country is divided geographically by the South China Sea. *West Malaysia*, located at the southern end of the Malay Peninsula, consists of 11 states. It was formerly the country of Malaya. *East Malaysia*, located on the northern coast of Borneo, consists of Sarawak and Sabah, two former British protectorates.

Malaysia's climate is hot and humid; the monsoons bring heavy rains. Dense jungle covers more than two-thirds of the land, and mountains run north to south down the centre of West Malaysia. Most people live in the low coastal areas, especially in the west. Villages are often constructed of thatched-roofed houses built on stilts above swampy ground. The capital and chief city is Kuala Lumpur.

The population of Malaysia is 10,800,000. About 45 per cent of these are Malays, who follow the Muslim religion and speak Malay, the official language. Chinese make up about 35 per cent, and Indians 9 per cent of the population. These groups speak their own languages and practise different religions. Dyaks and other non-Malay natives, living primarily in East Malaysia, make up the remainder of the population.

Malaysia enjoys one of the highest standards of living in Asia. Its prospe-

Above: Women sorting groundnuts, a valuable source of edible oil. Ground nuts thrive in Malaysia's hot damp climate. Below: A farmer cools his buffalo by throwing water over it. Buffalo are still widely used to plough rice paddies.

rity is based on valuable exports such as rubber, tin and timber. Palm and coconut oil are also sent abroad. Oil is found in East Malaysia and refined there. Although Malaysian farmers grow rice and other crops for home consumption, the country still has to import large quantities of rice and other food items.

When the Federation of Malaysia was originally formed, Singapore was included, but in 1965 it withdrew over conflicts between the Chinese and Malays, a problem the Federation still faces.

Facts and Figures
Area: 128,654 square miles.
Population: 10,800,000
Capital: Kuala Lumpur

Maldives. This is a tiny island nation located in the Indian Ocean off the southern coast of India. It consists of more than 2,000 coral islands of which only 220 are inhabited. The total population is 114,000. Male is the capital. The islands are low-lying with a hot, humid climate. The Maldivians, mostly fishermen, smoke their catches for export to Ceylon. Coconut is a second export. Rice and other essentials are imported.

The Maldives were originally settled by people from Ceylon, and ruled by Muslim sultans for many centuries. They came under British protection in 1887. In 1965, independence was achieved, and three years later the sultan was replaced by an elected president.

Mali is a country in western Africa. It is generally flat, and has an area of 463,949 square miles. It has no coastline. Mali has a dry climate. The Sahara desert covers the northern half of the country. Farther south are grasslands and trees. The land around the Niger River in the south-east is the most fertile. Mali has a population of 4,900,000. Most of the people are Muslims. They are chiefly farmers. They raise livestock, and grow cotton, millet and groundnuts. Mali became an independent republic in 1960. Before that it was a French colony. Its capital is Bamako.

Location map of Mali.

Malta is an independent nation in the Mediterranean Sea. It consists of five islands, the most important of which are Malta and Gozo. The others are Comino and the uninhabited Cominetto and Filfla. The islands lie about 60 miles south of Sicily. The capital, Valetta, has one of the finest harbours in the world.

Malta has pleasantly hot summers and rarely has frost in winter. Farmers grow crops on all the land that can be cultivated. They grow barley, lemons, onions, oranges, potatoes, tomatoes and wheat.

The people of Malta have their own language, Maltese, but most of them also speak English. Nearly all of them are Roman Catholics, and religion plays an important part in their lives. The people of the tiny village of Mosta, on the island of Malta, built a church that has one of the biggest domes in the world.

Malta's wealth depends partly on work in the shipyards. Valetta's harbour was once used as a British naval base. Today it is used for repairing ships.

The Knights of St. John of Jerusalem, a Roman Catholic religious order, made their headquarters on Malta in the 1500's. They resisted a long siege from the Turks. Malta became a British colony in 1815. During World War II, the Maltese fought off prolonged air attacks by German and Italian forces. For their courage, Malta was awarded a medal called the George Cross by the British king. The island became independent in 1964.

In the early 1970's Britain still maintained a military base on Malta, although disputes with the Maltese government over the rent that should be paid for the base caused a temporary withdrawal.

Left: Malta s strategic position in the Mediterranean and the fine harbour at Valetta made it an important British naval base for many years.

Below: Umbrellas are used in Malta as a protection against the Sun rather than rain. The climate has given the island an important tourist industry.

Facts and Figures
Area: 122 square miles.
Population: 325,000.
Capital: Valetta.

Mammals form the most advanced group of all animals. They are the most highly developed of the vertebrates (animals with backbones) and are the dominant land creatures over most of the Earth. Man is a mammal. So are mice, cattle, whales, dogs, bats, elephants, hedgehogs, and many more.

Various features distinguish mammals from all other creatures. The most obvious is the fact that female mammals have *mammary* (milk) glands with which they feed their new-born young. These give mammals their name. Hair is another characteristic of mammals. Even apparently bald mammals such as whales have a few bristly hairs. Along with birds, mammals are the only creatures to maintain a constant body temperature (they are said to be *warm-blooded*).

Most—but not quite all—embryo (unborn) mammals grow within their mother's body until they are quite well developed. But this feature is not unique to mammals—some fish, for example, also bear live young. And some primitive mammals, such as the platypus and spiny anteater, lay leathery-skinned eggs like those of reptiles. These mammals are called *monotremes*. *Marsupials* are another primitive group. Their young are born at a very early stage of development and grow further in their mother's pouch (see Marsupials).

Mammals are the only vertebrates having a single bone in the lower jaw. Bio-

There are three main groups of mammals: the monotremes, primitive, egg-laying mammals such as the Australian echidna and long-beaked echidna (below); the marsupials, pouched mammals such as the flying phalanger (left); and the placentals, the largest and most advanced group which contains such animals as the gibbons (right).

logists have found fossils with this feature dating from the period of the great reptiles, such as the dinosaurs, some 200 million years ago. These—the first mammals—probably survived the great climatic changes that killed the great reptiles, because they had already developed fur and warm blood.

From these creatures, the size of rats, a vast variety of mammals developed, suited to widely varying conditions in nearly every part of the world. Present-day mammals show a greater variety of forms than any other group of animals—yet there are only about 4,200 species (distinct kinds) of mammals, compared with 6,000 living species of reptiles, 9,000 of birds, 30,000 of fish, and 800,000 of insects.

Man is the most successful creature on Earth. He has virtually conquered nature, so that he can live safely almost anywhere he wishes. He has tamed other animals, changed the world he lives in, and even discovered how to harness the power that holds together the atoms that make up matter. He is the only creature ever to have left the Earth for another world.

In spite of these achievements, man is not very different in most ways from the other members of the class of animals to which he belongs, the *mammals* (see Mammal). He has the same bones, muscles, organs and glands. Unlike many creatures, man has not developed specialized features that help him to live in any particular *environment* (surroundings). He is not particularly strong for his size, though he has great endurance, or lasting ability.

There are two main physical characteristics in which man does differ from all other mammals. Firstly, he walks upright on only two feet, leaving his hands completely free to do things. Secondly, the size of his brain—in comparison with

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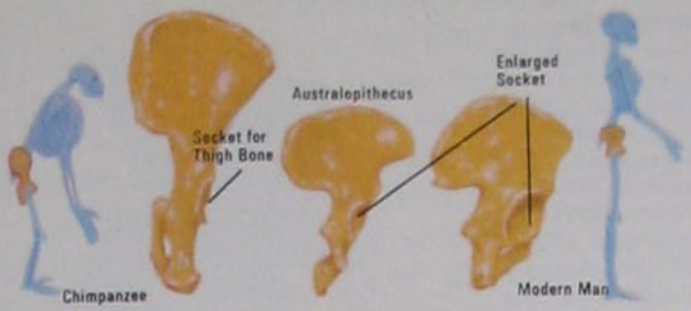
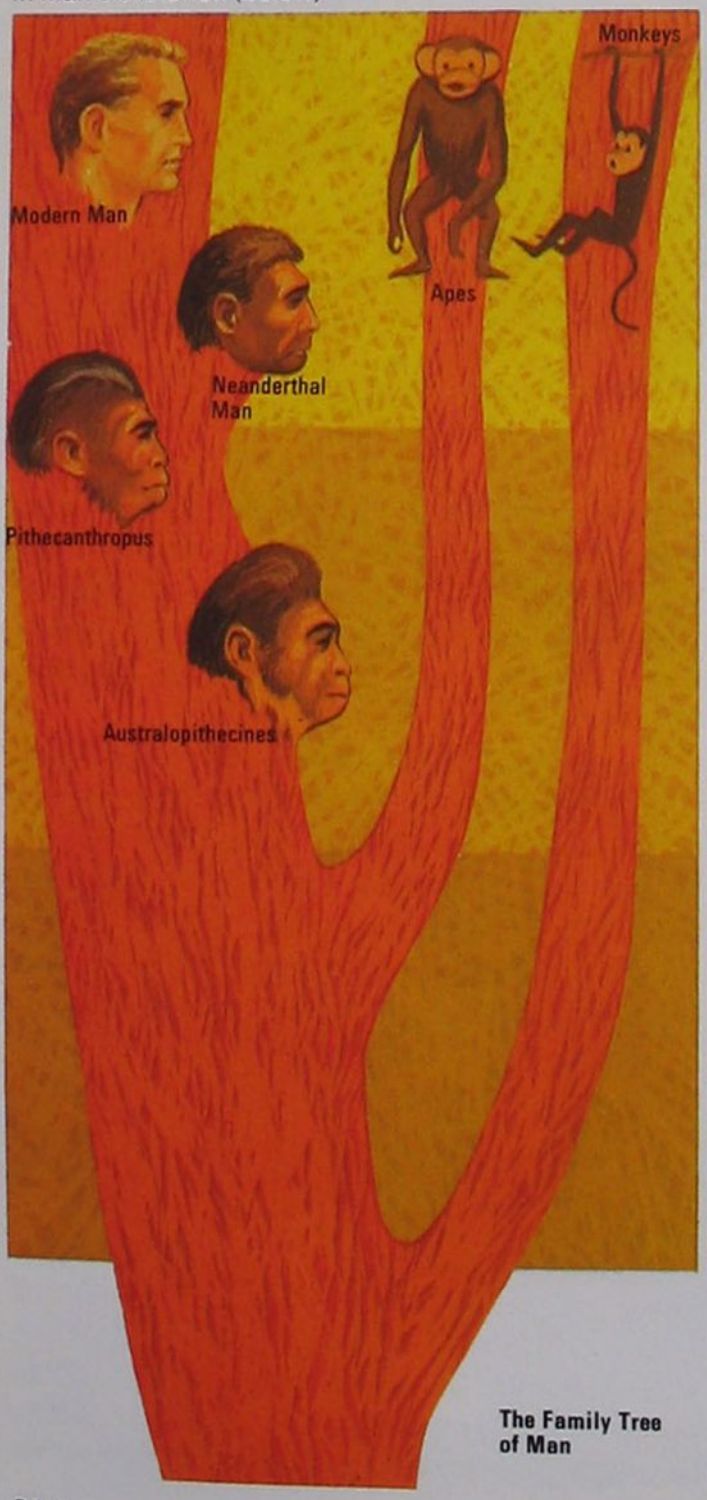


The pelvic girdle evolved in such a way that man is now able to walk upright (above).
Man's exact origin is not certain but scientists believe that his ancestors resembled the apes, though they evolved separately and on different lines. Evidence from fossils enables experts to picture various stages in man's evolution (below).



The Family Tree of Man

his body size—is enormous. It is, of course, from this second fact that all man's other differences from animals stem.

Man is a reasoning creature. He can think about a problem in his brain, imagine a solution, plan what to do, and then carry out this plan. Man's brain enables him to alter his environment and to grow food—instead of simply hunting for it. But perhaps an even greater achievement of man's brain is communication. Men can convey detailed information to each other, using the system of noises we call *language*. Many animals use sounds to convey warnings and other basic information, but they cannot communicate *ideas* in the way human beings can.

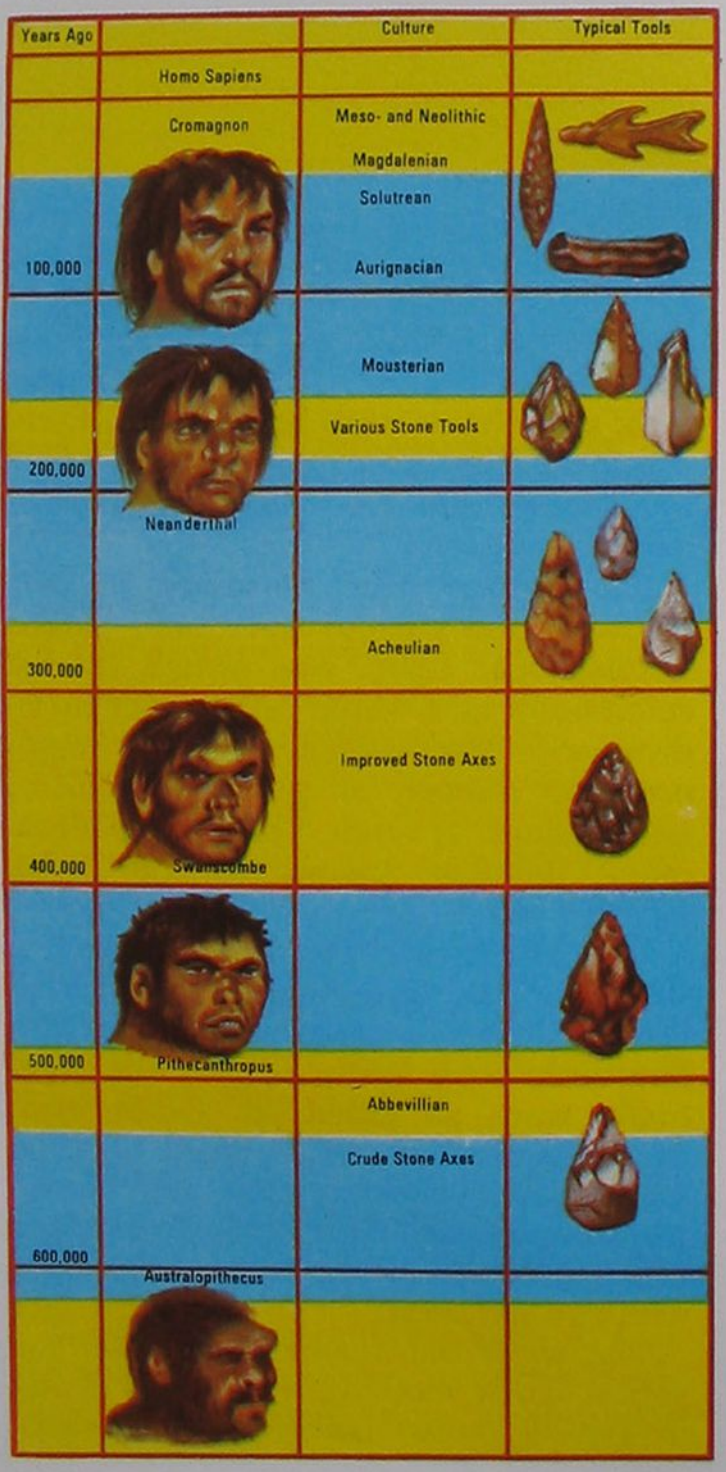
Communication is the key to learning, and this is another important difference between man and other animals. Most of man's *behaviour* (actions) is learned, whereas a far greater proportion of animal behaviour is instinctive, or inborn (see Instinct; Learning).

Yet man does have instincts, though rather vague and general ones. He is, for example, a basically *communal* creature—that is, he likes the company of other men. But he is not really what scientists call *gregarious*, except in some primitive cultures, where tribes live as one big family. In eating, man is *omnivorous*—he will eat almost anything. He likes to have his own piece of land and build his home on it—as many wild animals do.

Men have probably lived on Earth for about 500,000 years. Scientists do not know where or what the original men came from, but they believe that their ancestors were very similar to the ancestors of present-day apes. With evidence from fossils, they have been able to guess what men at various stages of their development looked like. One, called *Australopithecus*, was a very primitive man-ape about 3½ feet tall with a brain half the size of a modern man's. It is not certain whether this creature used stones as tools—the ability that is taken by scientists to divide men from apes. In

1972 Richard Leakey discovered the remains of the skull of a prehistoric man in Kenya. The skull is 2,600,000 years old—the same age as the early Australopithecenes—but has a larger brain and does not have the thick ridge of bone above the eyes which is a feature of apes and not men. In the light of this discovery, it seems likely that we are not descended from the ape-like Australopithecus.

A later type called *Pithecanthropus* was taller, had a bigger brain, and *did* use tools. Some tools have been found alongside his fossil bones. But he did show some ape-like features, such as a protruding jaw and eyebrow ridges. A later type, *Neanderthal man*, also had ape-like features. Scientists now believe that he was a 'side-branch' of human development—that is, he simply died out and was not an ancestor of modern man. The last major stage before modern man was *Cro-Magnon man*. This type included the first artists: many Cro-Magnon cave paintings still exist.



Today, all men belong to the same *species* (kind of creature), classified as *Homo sapiens* ('thinking man'). But there are various groups, or *races*, within this species. Most scientists agree that there are three main groups. They are the *Caucasoid*, which includes the fair-skinned peoples of Europe, the Polynesians of the Pacific, and others; the *Mongoloid*, taking in most of the yellow-skinned peoples of Asia plus the American Indians; and the *Negroid*, consisting of the dark-skinned peoples.

Man, Isle of (area 227 square miles) is a mountainous island off the north-west coast of England, in the Irish Sea. Although the island has self-government, the United Kingdom is responsible for its external affairs, such as defence. The capital is Douglas, and the population is 49,700.

About half the island is under cultivation, the main crop being oats. Some 50,000 holiday-makers visit the Isle of Man each year, and tourism is the main industry. Among the attractions are the annual motor cycle Tourist Trophy races. Unique to the island are the tailless Manx cat, and the dying Manx language.

Manchester (pop. 541,000) is a city and county borough in the county of Lancashire, England. It is the commercial centre of a large industrial region and a centre for the cotton trade of outlying towns. It is also a port and, though 35 miles inland, has access to the sea by the Manchester Ship Canal. The city dates

back to Roman times when it was a minor station called *Mancunium*. The city has fine buildings. The fifteenth-century cathedral is famous for its beautifully carved stalls. Chetham's Library, founded in 1653, is the oldest public library in continuing existence in Europe.

Location map of Manitoba.

Manitoba is one of the 'prairie provinces' of Canada. These provinces grow much of Canada's vast crop of high-quality wheat.

Manitoba lies in the centre of the country. It borders on the Northwest Territories and the provinces of Saskatchewan and Ontario. To the north-west lies Hudson Bay. To the south is the United States. The area of the province is 251,000 square miles. Part of Manitoba consists of flat or rolling plains. There are also forests and extensive rocky areas rich in minerals. The province has numerous rivers. These provide hydroelectric power. The largest of Manitoba's many lakes is Lake Winnipeg.

Manitoba has 981,000 inhabitants. About half of them live in the city of Winnipeg in the south. This is one of Canada's most important manufacturing and distribution centres. Processed foods, railway machinery and steel are made there. Manitoba's mines yield copper and nickel. Although cereals are the chief agricultural products, farmers also raise beef and dairy cattle.

The first Europeans to visit Manitoba were trappers. The Hudson's Bay Company of England gained control of the territory in 1670. Exactly 200 years later Manitoba became a province within the Dominion of Canada.

Maoris inhabited New Zealand before the arrival of Europeans. Today, they number about 232,000, or roughly eight per cent of the country's population. Since European colonization, many Maoris have intermarried with whites, so that only about a fifth are full-blooded. Most Maoris live on North Island, particularly around Auckland.

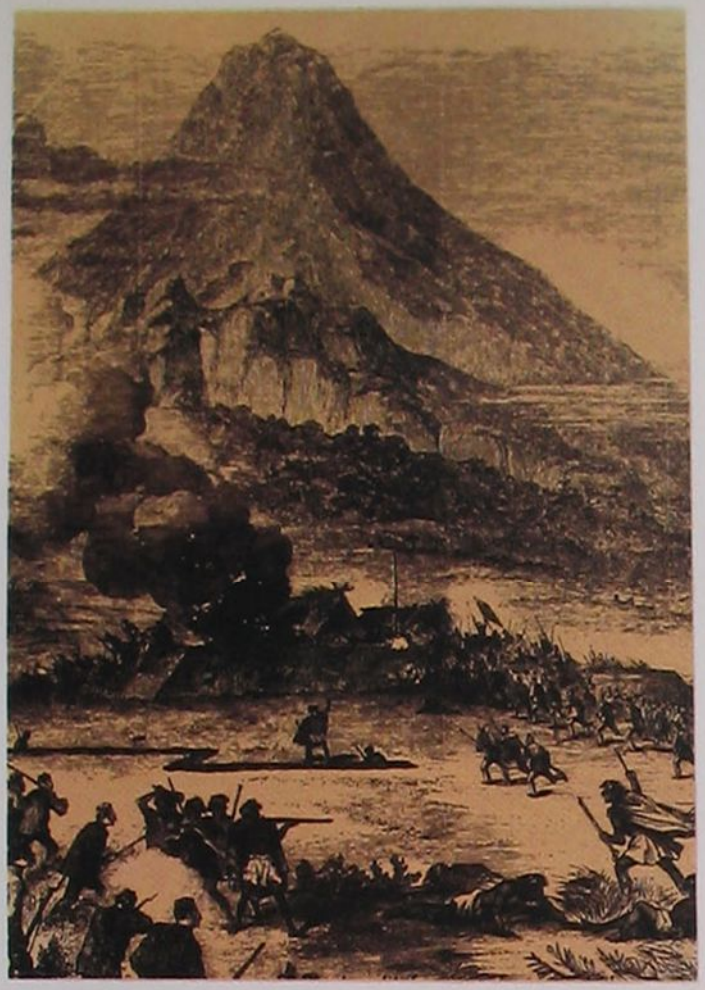
The Maoris are a Polynesian people. They are tall, dark-haired and dark-eyed, with strong features and light brown skin. Their native language belongs to the Malayo-Polynesian group.

Traditionally, the Maoris were organized into clans and tribes of families claiming a common ancestor. A chief headed the tribe and certain people were considered nobles. Fighting between tribes was common, and Maoris were trained to be fierce warriors. They prepared for battle with war-dances, and used clubs, spears and darts as weapons.

Each Maori tribe possessed its own territory, and villages were built behind fortifications. Land was owned by the community as a whole rather than by individuals. Rush-roofed wooden houses provided shelter, or places to cook or store things. A large, often richly decorated building served as the tribal meeting place.

The Maori diet was varied. They ate shellfish, eels and such other fish as they could catch. Moas and other flightless birds were easily caught, but eventually were all killed off. Other birds were snared with traps rigged in trees. The Maoris collected ferns and berries from the forests. Their farmers cultivated sweet potatoes as the main crop, along with taro and yams.

The art of the Maoris is beautiful and varied. Their clothing was woven of flax in typical *taniko* (geometrical) designs.



Above: Soldiers attack a Maori hill-top fort in the war of the 1860's. Right: A carved wooden post from a Maori meeting house. The two figures represent ancestors.

Red, white and black were the common colours. Fringes hung from some garments and kiwi feathers provided more decoration. Both sexes wore capes. The Maoris also wove patterned baskets of flax.

They painted geometrical designs—zig-zags, diamonds, rectangles and curves—on their buildings and canoes. Skilled at carving, they made large wooden totem poles and other smaller objects. They even decorated their faces with tattoos. Women tattooed only their chins; men sometimes covered their entire faces, as well as parts of their bodies.

Maoris had many gods and believed in evil spirits. Tribal priests made *taboos* (restrictions that had to be obeyed). But by the mid-1800's most Maoris had been converted to Christianity.

The first Maoris probably came to New Zealand by canoe from more northerly Pacific islands, some time in the 900's

A.D. The largest wave of them came in 1350. According to legend this was called the 'Great Fleet'.

In 1840, Britain concluded the Treaty of Waitangi with the Maori chiefs. By this, the Maoris became British subjects and agreed to sell land only to the government. In exchange, Britain agreed to protect their rights.

But as it turned out, land disputes soon arose, and there was a growing fear among the Maoris that they would find themselves completely stripped of territory. Differences between Maori and European ideas of ownership added to the problem, as did religious conflicts.

By 1845, the first uprising of the so-called *Maori Wars* took place at Russell. It was crushed by the government in the following year, but during the 1860's other tribes staged rebellions. Among these were a number of tribes in the Waikato district, which had united under an elected king. This became known as the *King Movement*.

The fighting continued for 10 years before all the rebellions were defeated. When peace was restored, much Maori land was confiscated, including territory belonging to tribes that had fought as allies of the government. By 1900, wars and disease had greatly reduced the Maori population.

Gradually, the bitterness receded, and Maoris were accepted into modern New Zealand life. By the 1960's most were living in cities rather than rural areas. Fortunately, New Zealand has not had the severe racial problems of other countries. At the same time, the King Movement and other groups are working to ensure that Maori culture does not die out altogether.

Mao Tse-tung (1893-) is the leader of China, the third biggest country in the world, and governs more than 700 million people. He controls the government as chairman of the Chinese Communist Party. He was head of the government of China (the People's Republic) from 1949 to 1959. He showed his millions of poor people the way to work hard and make China a powerful country, with factories as well as farms.

Mao Tse-tung (left) leader of the Chinese, aims to keep the ideals of his early Communist revolt fresh and in line with the early inspiration of the country's struggle against the Japanese. As a result, the world Communist movement has been split into two factions —one supporting Russia, the other favouring China.

Mao was born in Hunan province. He was the eldest son of a farmer. He trained to be a teacher, but in 1921 he helped to form the Chinese Communist Party. The other party, the Nationalists, under Chiang Kai-shek, tried to stop Mao from getting power. But Mao became leader of the Communist Party, and built up an army to fight the Japanese invaders. After the Second World War he drove the Nationalists on to the island of Formosa, and in 1949 became head of a Communist government. He wanted China to make a 'Great Leap Forward'— that is, to become as rich as Western countries as quickly as possible. But much of the land was poor and many of his plans to improve it did not work.

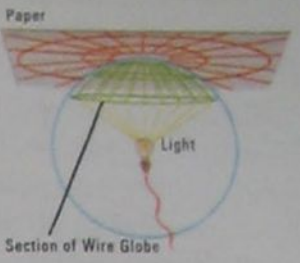
Mao resigned as chairman in 1959, but continued to hold a position of influence. He had many arguments with Krushchev, the head of the Russian government. Krushchev wanted 'peaceful co-existence' —that is, he felt that East and West should follow their own ideas. But Mao considered the West, especially the United States, as enemies, and that all countries should be forced to become Communist. In 1966 Mao again became leader of the government, and began the 'cultural revolution'. In this the young Red Guards purged those they considered

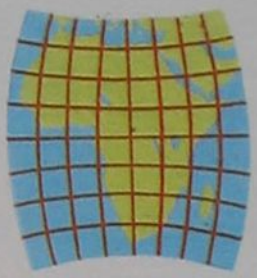
to be anti-Communists from positions of responsibility. *Xenophobia* (fear and hatred of foreigners) was also a feature of the period, and the 'Little Red Book' of the thoughts of Mao became compulsory reading. In the early 1970's, Mao became more of a background figure, while China improved relations with the West.

Maps and charts are essential to help us find our way over the Earth's surface. A *map* is a representation of the land, complete with cities, mountains and lakes, roads and railways, and many other features. The sea is represented on a *chart*. It tells the navigator where there are navigable channels, rocks, lighthouses, and so on, and indicates the depth of the water. *Star maps* show representations of the constellations of stars in the sky.

Most maps show continents, countries and cities. Physical maps show the terrain—mountains, plains, rivers and lakes. Political maps show little terrain, but concentrate on countries and their frontiers, cities and towns, and road and rail communications. Both these kinds of maps are found in *atlases* (books of maps), together with special maps showing rainfall and temperature, population density, and the distribution of certain crops or livestock, or even of illnesses. Governments produce highly detailed maps of their countries. These maps are as near a complete representation of the land as it is possible to get, and they are drawn to a large scale. They are of great value to travellers.

A map must be drawn to scale if it is to be accurate. Large-scale maps show roads and other details, including individual houses. These maps are drawn at scales larger than 1 inch to the mile. This means that one mile of the land is represented by one inch or more on the map. Small-scale maps are necessary to show individual countries or the whole world. To show Britain over two pages of a large atlas requires a scale of 1 inch to 50 miles, and for the United States, 1 inch to 200 miles. To show the entire world, the scale might be 1 inch to 1,000 miles. The scale of a map is often shown on a graduated line beside the map.





Azimuthal projections are those in which the surface of the Earth is projected onto a flat piece of paper the centre of which touches the globe. This projection can be demonstrated by placing a piece of paper above a wire globe containing a light (top right). The shadows of the lines of latitude and longitude (the wires) cast on the paper take the form of concentric circles with straight lines radiating from the centre (centre right). This projection is often used for polar regions. The paper can, of course, touch the globe at any point, such as at the Equator, to obtain a projection (bottom right). Azimuthal projections are frequently modified for a particular purpose. Modified projections are called *non-perspective* because they cannot be obtained in the true manner of projection.

Small-scale maps cannot show important but small features to scale, and so they employ symbols. Roads and railways are usually shown as red and black lines. If they were drawn to scale, the lines would be so thin as to be invisible. Cities and towns are often marked as black circles or dots, unless they are very large, in which case they are indicated by their boundaries. Some symbols resemble the features they represent. Forest land is sometimes shown as a group of tree-like symbols, and the symbols for a marsh may look like small tufts of grass.

The relief of the land is shown by different methods. Contour lines connect points of the same height—they are usually brown in colour. Layer colouring shows land at various heights in different colours. Pink or white may be used for

land below sea level, such as the Jordan valley, with green, yellow, buff, brown and purple indicating successively higher regions. Sea depth is shown by various shades of blue.

All maps and charts are criss-crossed by a network of lines. On most maps, these lines indicate latitude and longitude (see Latitude and Longitude). But on government maps, they may represent a *national grid*. The grid works in exactly the same way as latitude and longitude, but it is slightly more accurate in fixing the position of places, and it is easier to use.

Maps are made by various kinds of *projections*. As the Earth is round and can be represented accurately only by a globe, a flat map presents a distorted picture of large areas. There are several ways in which the Earth's curved surface can be projected on to a page. *Azimuthal* projections are used for small-scale maps of the poles and hemispheres. The *gnomonic* projection is a useful azimuthal projection because it shows the Great Circle (the shortest route between two points) as a straight line. *Cylindrical* projections, such as *Mercator's* projection, are useful to navigators as they show a compass bearing as a straight line. But they distort areas—India is shown on Mercator's projection as being smaller than Alaska, whereas it is really twice as large. *Conic* projections are the kind often seen in atlases; they give little distortion to shapes

Talking points

*What are the problems of drawing a map of the world? Which of the projections that are illustrated gives the most accurate picture of what the world looks like?

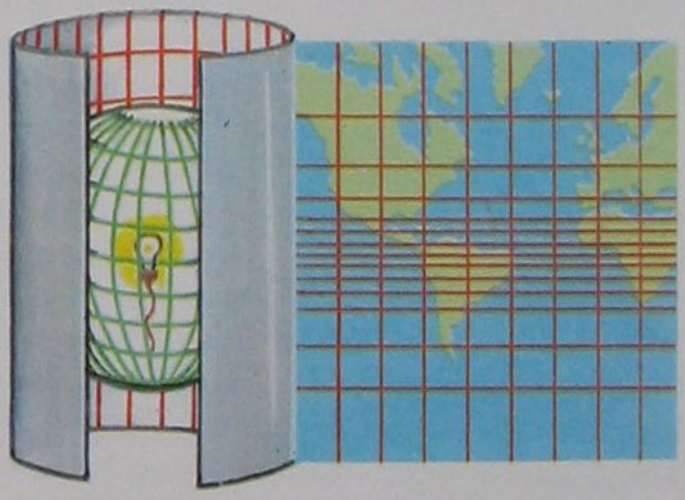
*Get an aerial photograph of your nearest town (the public library should have one). From it draw a map of the town, then compare it with the official map.

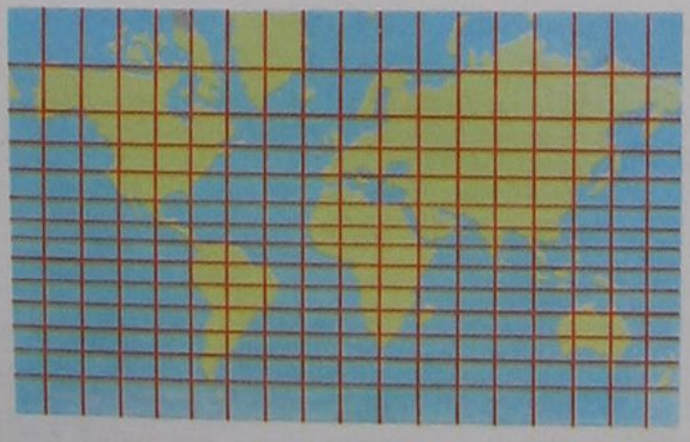
*Next time you go for a walk in the country, take a large scale map of the area with you. Try to identify the features on the map as you walk past them. Mark in the route that you take on the map in pencil.

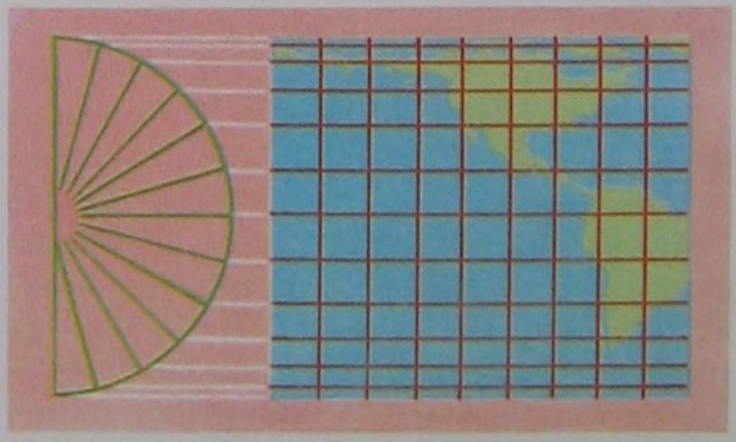
Articles to read

Maps of the continents; Compass; Latitude and longitude; Navigation; Surveying.

In cylindrical projections a piece of paper can be imagined to be wrapped around a wire globe and the lines of latitude and longitude projected on to it by a light source at the centre. When the paper is unrolled, latitude and longitude lines form a *graticule* (grid) on which a map of the world can be drawn. The simple cylindrical projection is of little value because the scale is progressively exaggerated away from the Equator in all directions (right). Consequently, it is usually modified in some way. In Mercator's projection (below) the space between the lines of latitude is adjusted so that the shape of the land remains true at any point on the map. Areas are greatly exaggerated in high latitudes, however. In another projection (below right) the distance between the lines of latitude is progressively reduced away from the Equator so that areas always remain true, though the shape of northern and southern lands seems strange because they are stretched east-west and squashed north-south.



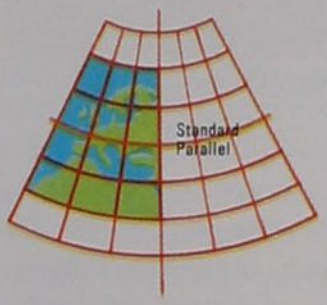


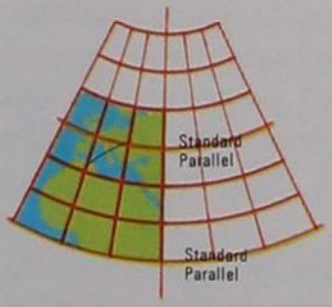


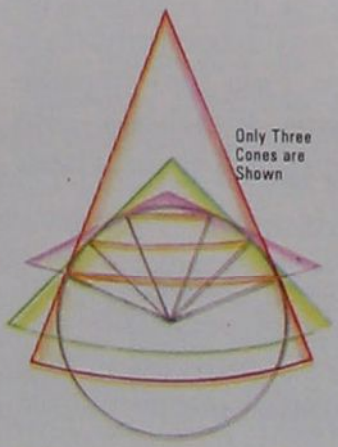
and areas, although lines of latitude and longitude are curved.

Maps are made from measurements supplied by surveyors (see Surveying) and from photographs taken from aircraft.

Marconi, Guglielmo (1874-1937), was an Italian inventor and pioneer in the field of wireless communication. He was born in Bologna, where he carried out his first experiments at home. He first developed a working aerial, then in 1895, succeeded in sending a wireless signal over a mile. Marconi moved to England, where he patented his invention and set up a wireless company. He sent the first messages across the English Channel and the Atlantic Ocean, convincing governments of

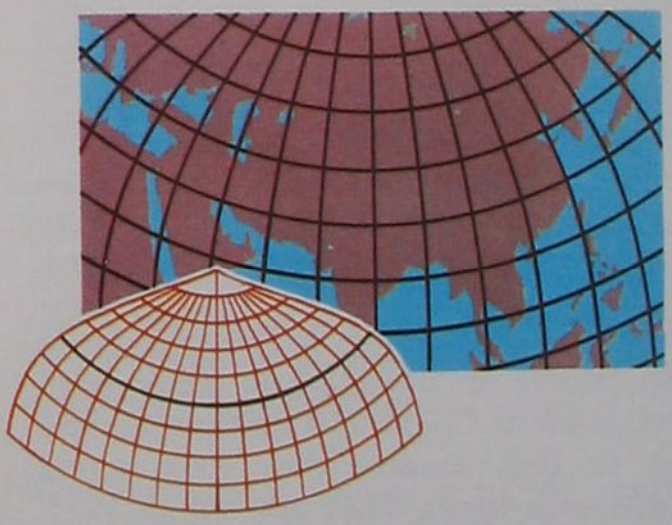




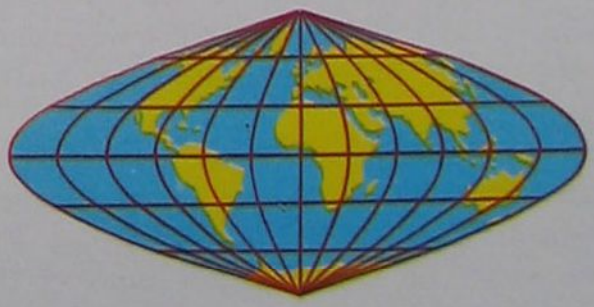


In conical projections the paper can be imagined to rest on the wire globe in the form of a cone. The lines of latitude and longitude (the wires) are then projected onto the paper from the centre of the globe (top illustration). When the paper is opened the lines of longitude converge towards the Pole while the lines of latitude take the form of arcs of concentric circles. East-west distances are true only where the paper touches the surface of the globe and this line of latitude is called the *standard parallel*. Conical projections are usually modified so that the lines of latitude are the correct distance apart (second illustration), making north-south distances true everywhere. Sometimes two standard parallels are drawn in, which reduces the east-west exaggeration (third illustration). The polyconic projection (fourth illustration) is drawn with every line of latitude a standard parallel, i.e. as though there were a separate cone of paper touching the globe for every line of latitude. The lines of longitude are then drawn in so that they are correctly spaced along every line of latitude. The polyconic projection, with slight modifications, is used as the basis of the International map.

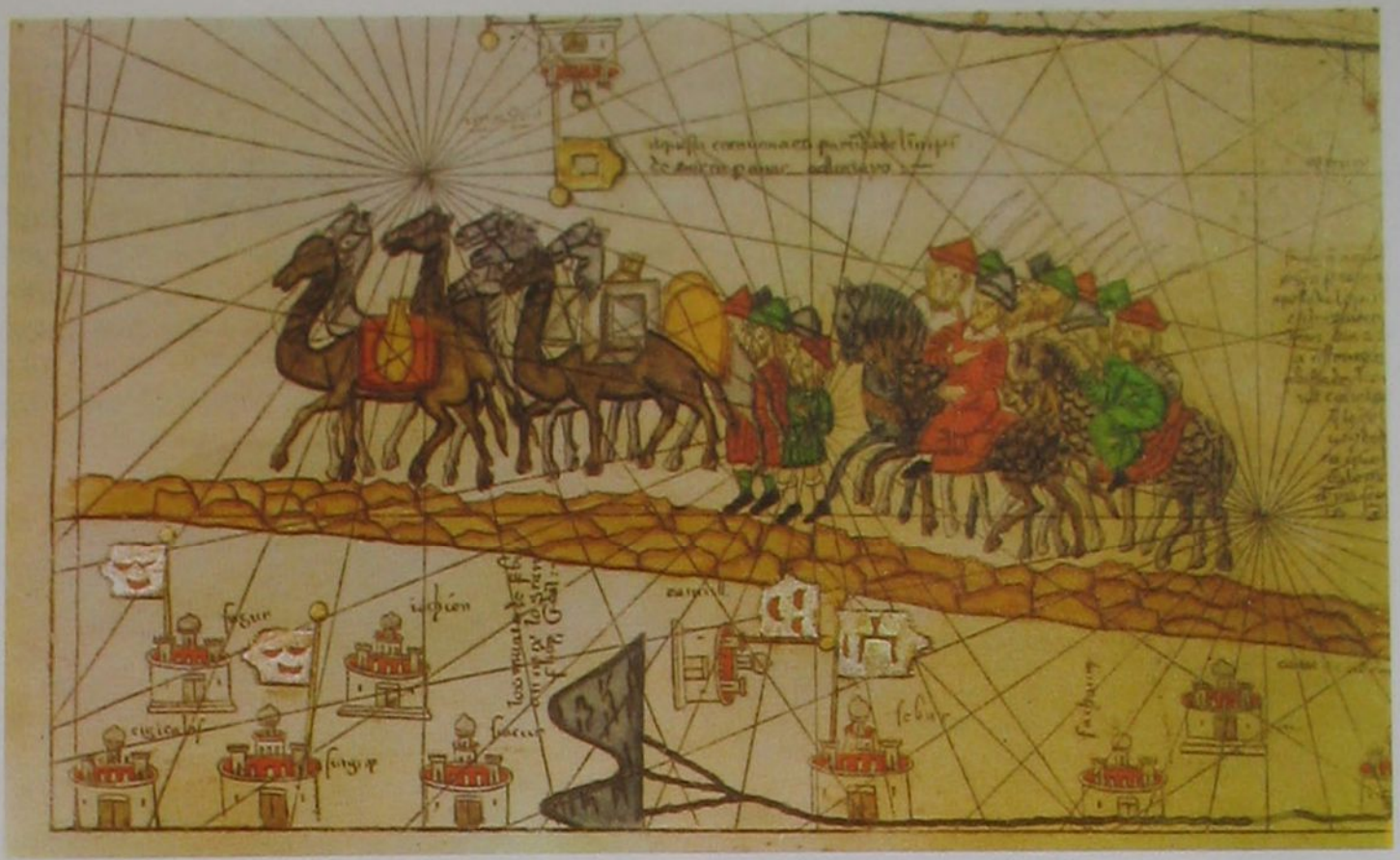
In the Mollweide projection the grid, or *graticule*, is not projected in any sense but constructed to a definite plan. The scale is true at every point.



Bonne's projection is a highly modified conical projection in which the scale is true at every point.



In the Sanson Flamstead projection the graticule is constructed in such a way that the scale is true at every point, but the shape of the land is distorted on a world map.



An old illustration depicting Marco Polo's journeys throughout the East.

the practical value of wireless for ship-to-shore communication. Among the many honours he received was the Nobel Prize for physics in 1909.

Marco Polo (1254?-1324?) was an Italian traveller who took part in one of the longest land voyages of the Middle Ages. His father and uncle were Venetian merchants who travelled widely to trade with people in other lands. They even went as far as China, and on their second visit to that country they took young Marco with them. They set out in 1271, crossing Persia, western Asia, and the Gobi desert—places almost unknown to Europeans in those days. They reached Peking in 1275, where they were welcomed by the great Mongol conqueror Kublai Khan.

Marco Polo made such a favourable impression that he was sent on missions to various parts of China and India. For three years he was also governor of the city of Yangchow.

In 1292 the three men started on their return journey. It took them three years to reach Venice. They accompanied an embassy to Persia by sea as far as the Persian Gulf, and then continued overland to Venice by way of Constantinople. They had been away for 24 years and were hardly recognized even by their relatives. At a banquet to celebrate their return, the travellers produced gorgeous silks and bags full of jewels. These were the fruits of their trading and gifts from Kublai Khan.

In 1298 Marco Polo was captured by the Genoese in a sea battle between Venice and Genoa. During his captivity he dictated the story of his journeys to a fellow prisoner. It was later published as *The Book of Marco Polo* and became so popular that it was translated into many languages, and inspired several later explorers.

Margarine is used as a substitute for butter. It can be made of vegetable oils and animal fats. When vitamins are added to it, it is almost as nourishing as butter, and is often cheaper.

The vegetable oils used in making margarine are obtained from the seeds and nuts of certain plants. The most important oils are cottonseed, sunflower, coconut, ground-nut (peanut) and sesame. Beef is the usual animal fat.

To make margarine, vegetable oils are treated so that they form a paste. Then salt, vitamins and a little milk are added, and the mixture is stirred rapidly in a drum or beaten by flexible knives in a pipe. This action produces a smooth, butter-like solid.

A French chemist, Hippolyte Mège Mouries, made the first margarine in about 1867. He won a prize offered by Napoleon III for a cheap substitute for butter. He made his so-called *oleomargarine* from beef suet and milk. It was white. Today, margarine is artificially coloured to make it look like butter.

Most people celebrate a marriage with ceremonies and often wear special costumes. Above: a group of Laplanders in procession. Below: a Sikh bride.

Marriage ceremonies vary greatly from country to country and from religion to religion. Some people regard marriage as merely an agreement between a man and a woman to live together. Other people regard marriage as of great religious and spirtual significance, demanding an elaborate ceremony.

In Protestant marriages the couple promise to love, honour, and cherish each other. They join hands and the minister places the ring on the bride's finger and then declares the couple man and wife. In Roman Catholic marriages the bride and groom kneel before the priest. He instructs them and then leads them in the marriage vows. He sprinkles with holy water and blesses the couple and the rings, which are then exchanged.

In most Buddhist countries marriage is not regarded as a religious occasion. But in Japan the bride and groom sip wine three times from three cups. In Hindu countries marriage is regarded as a sacred occasion. The couple perform many rites. At one point the groom leads the bride three times round a sacred fire. He then leads her in a ceremony known as the *seven steps*. At each step they recite a prayer. In Muslim countries marriages are not religious ceremonies, though an *imam* (leader of prayers) often officiates. In all countries of the world feasting and rejoicing follow marriages.

Marlborough Province is in the north-east of New Zealand's South Island. The province is bounded by the sea to the east and north. Nelson province lies to the west and south. Marlborough is 101 miles in length from north to south and about 70 miles in breadth at its widest point. It has an area of 4,220 square miles and a population of 31,600. The chief town is Blenheim.

There is some light industry centred on Blenheim, mainly food processing. The principal occupation is sheep farming and a third of the population is engaged in it. Much of the province is mountainous and fit only for rough grazing. Some crops,

such as wheat and barley, are grown in the centre of Marlborough.

In the north of the province there are a number of coastal inlets known as the Marlborough Sounds. This is a popular tourist area and the many secluded beaches provide good opportunities for sailing and water-skiing.

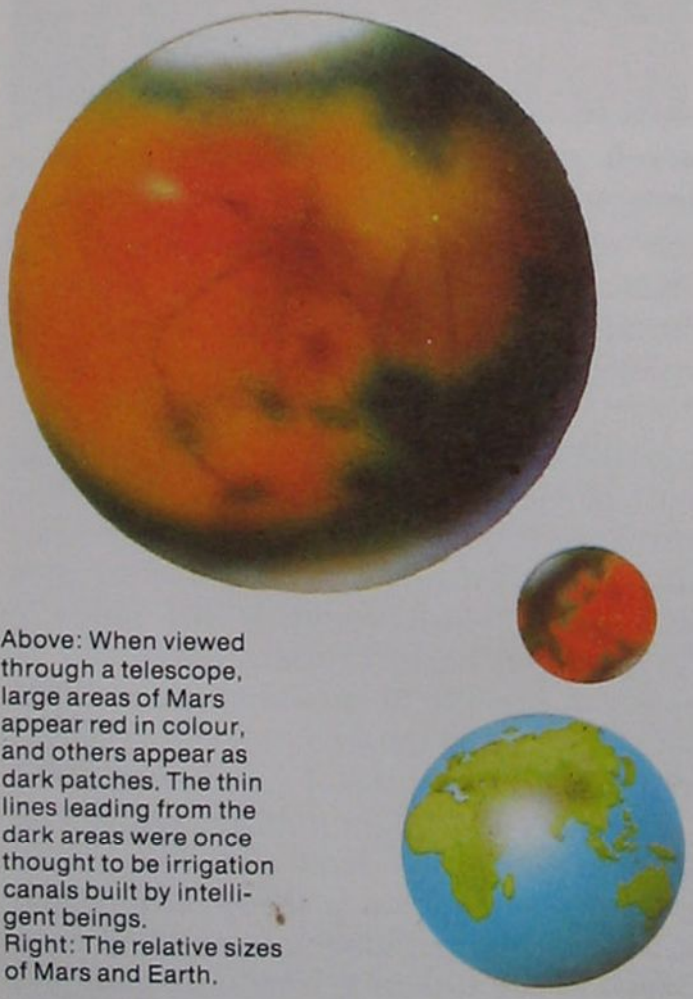
Mars is the fourth planet in order of distance from the Sun. It is the only planet having conditions even remotely similar to those on Earth. If life exists on any of the other planets, Mars is the most likely one. But the Martian atmosphere contains much less oxygen and water vapour than the Earth's atmosphere, and temperatures there vary greatly. At noon on Mars' equator, the temperature may reach 25°C (77°F), like a warm summer's day on Earth. During the night the temperature may drop to minus 40° C (minus 40° F), as cold as Antarctica in winter.

Mars has four seasons, just as we have on Earth. But each season on Mars is twice as long as on Earth, because Mars takes two Earth years to *orbit* (travel round) the Sun.

As seen through a telescope, about two-thirds of the surface of Mars seems to consist of desert-like regions, ranging from brick red to bright orange in colour. These regions may be sandy desert or may be vast stretches of reddish rock.

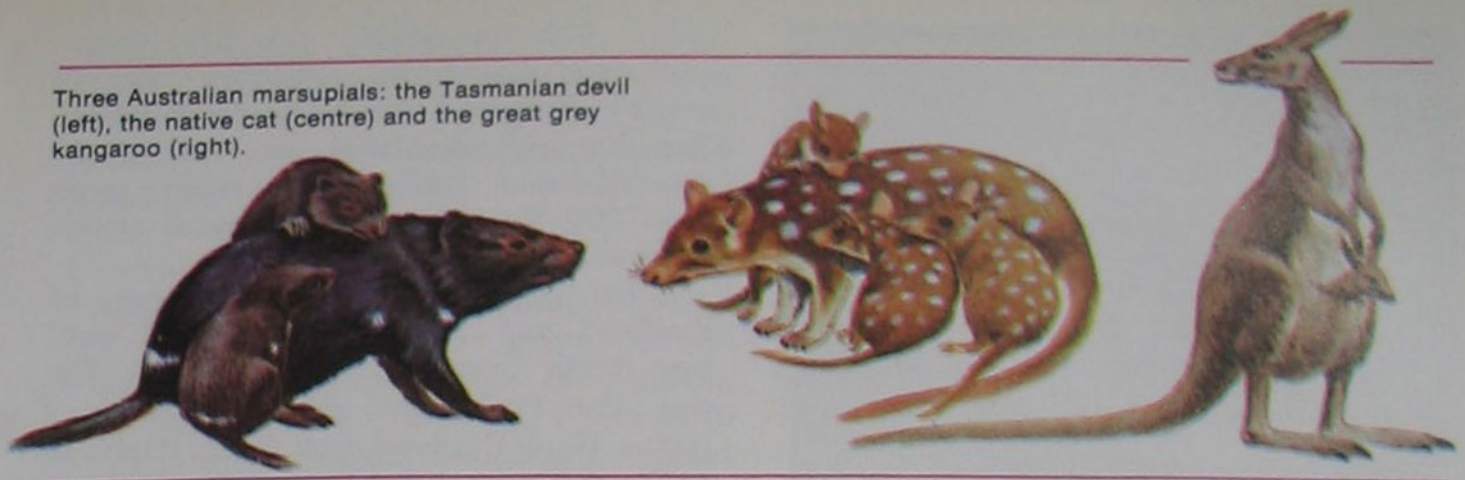
Like Earth, Mars has two white polar caps. These 'ice-caps' may be layers of frost only about an inch or so thick. During the Martian summer, the ice-caps shrink as the ice melts and the water produced possibly flows towards the equator. At this season, the dark patches on the planet's surface seem to change colour. From being brownish or grey they become slightly greenish. Because of this, some astronomers think that the dark patches may be areas of plant life, and that the plants there are revived by the coming of the water.

Seen through a telescope, the reddish areas of Mars' surface appear to be crossed by thin greyish lines that connect the dark patches. A few early astronomers thought that these were irrigation canals built by man-like creatures. However, pictures of the planet's surface, taken from only 7,000 to 10,000 miles away by the American space-probe Mariner IV in 1965, showed no signs of either canals or irrigation. The Russian Mars 3 craft made the first soft landing on the planet in 1971. It landed in a dust storm and transmitted pictures for 20 seconds.



Above: When viewed through a telescope, large areas of Mars appear red in colour, and others appear as dark patches. The thin lines leading from the dark areas were once thought to be irrigation canals built by intelligent beings.
Right: The relative sizes of Mars and Earth.

Marsupials are a group of mammals in which the female has a pouch where the new-born young develop. The pouch covers the mammary (milk-producing) glands. A new-born marsupial is tiny and only partly developed. It crawls into its mother's pouch and attaches itself to the nipple of a mammary gland. It



Three Australian marsupials: the Tasmanian devil (left), the native cat (centre) and the great grey kangaroo (right).

stays there, feeding on the milk, growing, and developing for weeks or even months. The pouch protects the young creature from danger, and even after it leaves the pouch it frequently returns for shelter.

From fossils, biologists know that marsupials existed well over 100 million years ago, at the same time as the ancestors of other present-day mammals. In most parts of the world the marsupials died out, displaced by more advanced mammals. In South America and southern North America, some marsupials – mainly opossums – survived (see Opossum).

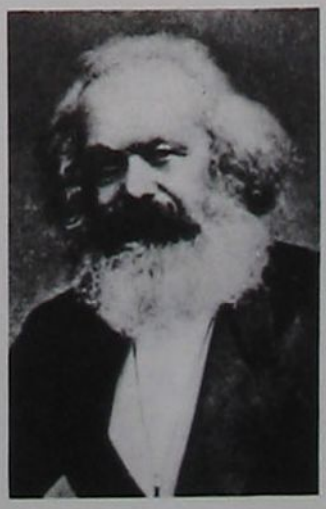
But in the Australian region there was virtually no competition, and almost all the mammals there now are marsupials. They have developed into a great variety of forms, many of them having direct equivalents among other mammals. There are, for example, many kinds of marsupial 'mice' and 'moles'. Probably the best-known marsupials are the kangaroo and the tree-dwelling koala (see Kangaroo; Koala). The grass-eating kangaroo is the equivalent of the deer. There are also marsupial equivalents of cats, squirrels and rabbits. Fossil remains have been found of a marsupial the size of a rhinoceros.

Marx, Karl (1818-1883) was a German philosopher who lived in the nineteenth century. His theories are the basis of Communism.

Marx believed that society is supported by the labour of the *proletariat* (working class). And the *capitalist*, or property-owning class, which controls society, keeps the proletariat down so that its own members can enjoy the benefits of this labour. He believed, however, that eventually and inevitably the proletariat would realize what was happening, rise against the capitalists, and take control of society.

For many years, Marx was content to write about his ideas and wait for this 'inevitable' uprising to take place. But as he grew older and still there seemed to be no sign of his predictions coming true in the near future, he became impatient. He decided that it was necessary to speak to the working classes, make them aware of their situation, and rouse them to action.

For this purpose he helped to found the First International Workingmen's Association. This was the beginning of the Communist movement. The First International broke up before very long, but Marx's ideas remained in the minds of all who attended it.



The German philosopher Karl Marx lived for some time in London, and researched at the British Museum. His book *Das Kapital*, is a study of economics from a socialist point of view. He is buried in Highgate, North London, England, and his grave is frequently visited by people in sympathy with his ideas.

Karl Marx spent most of his life in London. For most of the 34 years he lived there he was very poor and relied on his friend, Friedrich Engels, to support him. He earned a precarious living as a political reporter for the 'New York Tribune'. Despite his poverty, he had a happy family life.

These ideas led to the Bolshevik Revolution which took place in Russia early in this century and brought to Russia its Communist government.

Marseilles is France's second largest city, with a population of 898,000. It is also the leading seaport on the Mediterranean. Ships have been carrying goods in and out of its harbour since 600 B.C., when Greeks founded the city of *Massilia* on the site. It was later a Roman city. Marseilles became part of France in 1486. During the 19th century, the opening of the Suez Canal and the establishment of French colonies in North Africa increased its importance. Marseilles has shipbuilding industries, flour mills, oil refineries and ore smelting plants. Factories produce vegetable oils, soap, glass, tiles and bricks, chemicals, cars and machinery.

Mary is the name of two queens of England.

Mary I Tudor (1516-1558), was the daughter of Henry VIII and Catherine of Aragon. Much of her life during the reigns of her father and her half-brother, Edward VI, was unhappy. She was separated from her mother (whom Henry divorced in 1532), declared illegitimate, and harried because of her Roman Catholic beliefs.

On Edward's death in 1553, the Duke of Northumberland tried to place Lady Jane Grey on the throne. But Mary marched on London with a small army and easily secured the Crown. In 1554, after suppressing a rebellion led by Sir Thomas Wyatt, Mary married Philip of Spain. This alliance dragged her into a disastrous war against France, which resulted in the loss of Calais, England's last possession in France.

Mary's overriding ambition was to restore Roman Catholicism to England. But her religious zeal was marred by cruelty, and during her reign more than 300 Protestants were burnt at the stake for heresy.

Mary II (1662-1694), was queen of England and Scotland from 1689 until her death from smallpox in 1694. She was the Protestant elder daughter of James II of England and Anne Hyde. In 1677 she married her cousin, William of Orange. When James II was overthrown in the so-called Glorious Revolution of 1688, William and Mary accepted the offer of the English throne, and ruled jointly as William III and Mary II from 1689.

Mary proved to be a loving wife and a popular queen. But she exercised little political influence, preferring to leave the decisions to her husband.

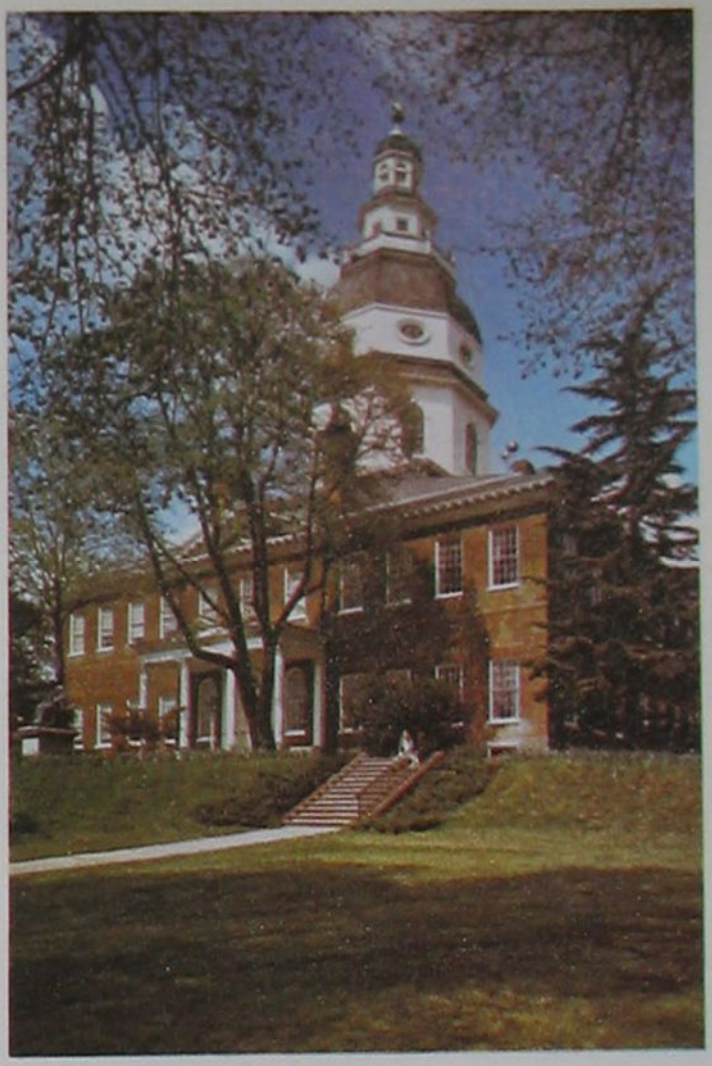
A portrait of Mary I at the age of 28. When she became queen, she had the enthusiastic support of the people, but her religious persecutions soon made her unpopular.

Mary (Stuart), Queen of Scots (1542-1587), was queen of Scotland from 1542 to 1567, succeeding her father, James V of Scotland. The Scottish monarchy was strongly Catholic, and leaned heavily on the alliance with France. As a child, Mary was sent to France, where she eventually married the *dauphin* (the name given to the eldest sons of the kings of France), who became King Francis II. From 1559 to 1560, when Francis died, Mary reigned with him as queen of France.

In 1561, Mary returned to a Scotland that had become fiercely Protestant in her absence. Four years later, she married her cousin, Lord Darnley. Their son became James VI of Scotland and I of England. He became jealous of David Riccio, one of Mary's secretaries, and had him murdered. Shortly afterwards, Mary fell in love with the Earl of Bothwell. In 1567, he organized Darnley's assassination, probably with Mary's consent. Mary and Bothwell were married, but her conduct had provoked a rebellion, and she was forced to abdicate.

Mary escaped from a Scottish prison to England, where Elizabeth I held her in prison for 19 years. She was finally executed for treason in 1587.

Maryland (area 9,891 square miles) is a state on the mid-Atlantic coast of the United States. It is famous for oysters, crabs and clams caught in its Chesapeake Bay. Annapolis, the state capital, is the home of the U.S. Naval Academy. Most of the state's 3,922,400 people live in cities, the largest of which is Baltimore. Maryland has large steel mills, and important machinery, chemical, food-processing and printing industries. Farmers raise dairy cattle and poultry, and grow tobacco and maize.

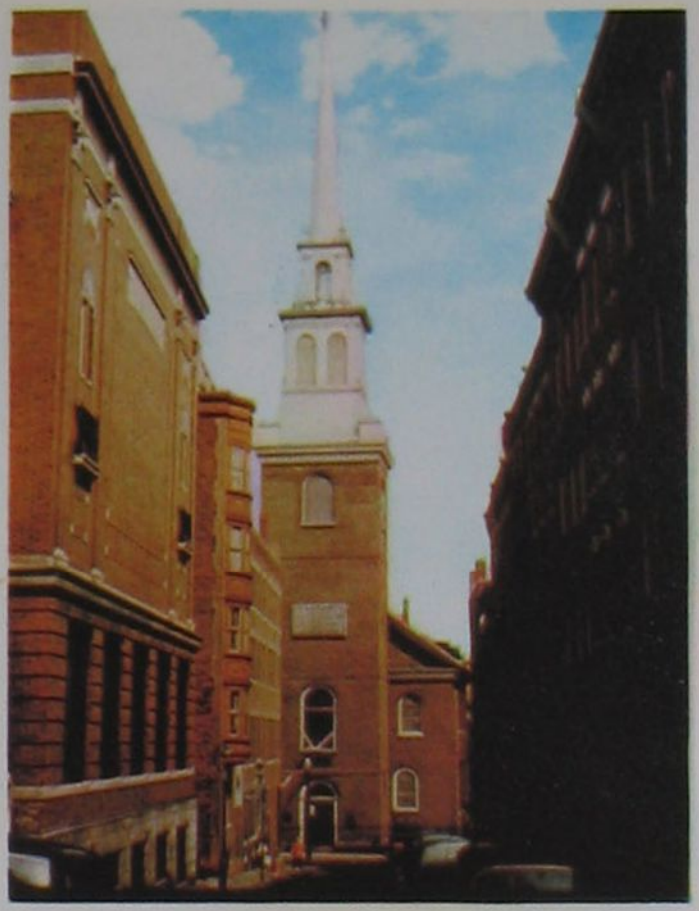


The State House at Annapolis, Maryland, is the oldest state capitol still in daily use.

Location map of Maryland.

One of the 13 original colonies, Maryland was founded in 1632 by Lord Baltimore as a haven for persecuted Catholics.

Massachusetts (area 7,826 square miles) bordering the Atlantic Ocean, is one of the New England states of the United States. The Pilgrim fathers, who were the first settlers in New England, landed near Massachusetts Bay in 1620. The state has many historic associations from colonial days. The Boston Tea Party occurred



An old street in Boston, Massachusetts. It is one of the earliest cities of North America. It was first settled in 1630.

there in 1773, and the first battles of the Revolutionary War took place at Lexington and Concord. Massachusetts has many fine universities, including Harvard, the oldest in the country. Many of America's leading writers came from the state or lived there, and presidents John Adams, John Quincy Adams, and John F. Kennedy were born there.

Massachusetts has 5,689,000 people, most of whom live in cities or towns. Boston is the state capital and largest city.

Location map of Massachusetts.

About a third of the people of the state work in manufacturing industries. Among the leading products are clothing, electrical machinery and leather goods. Fishing has been important since colonial times. Today, Massachusetts trawlers bring in catches worth over $40 million a year. There is also some farming and mining.

Matches were one of Man's most useful inventions. People all over the world use hundreds of millions of matches each day to light fires. Matches are small and easy to carry. And they produce a flame immediately when rubbed on the right kind of surface. A match consists of a *stick* and a *head*. The stick is an inch or two long, and is made either of wood or of cardboard. It is coated with paraffin wax at the head end. The head itself is made of chemicals. Some matches light if the head is rubbed on any rough surface. The heads of these matches contain *tetraphosphorus trisulphide* or a similar chemical. Around this is a coating of other chemicals which burn longer. Other matches, called *safety matches*, can only be struck on a special surface. This surface is usually a strip on the side of the box containing the matches. The strip contains the phosphorus that produces the flame.

Matches were invented in the 1600's. Safety matches first appeared in Britain in the 1830's.

At first, children and women were often employed to make matches. They hand-dipped the matches into the poisonous chemicals. As a result, they often suffered from a bone disease called *phossy jaw*. In 1906 an international agreement banned the manufacture of matches containing poisonous white phosphorus. Modern match factories produce thousands of matches every hour by mass production.

Mathematics is one of the most important areas of human knowledge. We start to learn mathematics almost as soon as we

start to talk, and everyone uses mathematics in some way every day. Every time you look at the clock, count the change given you by a shopkeeper, or calculate the amounts of food you need when cooking, you are using mathematics. At work, mathematics is essential to solve problems and to ensure that a business is operating properly. Computers are often used to make the complex calculations involved. Scientists depend on mathematics to express their observations in a precise way.

There are several branches of mathematics. *Arithmetic* is the branch that deals with numbers and calculating. We often use it in our everyday lives, and it has four basic operations—addition, subtraction, multiplication and division. Arithmetic is used for making calculations in other branches of mathematics.

Algebra uses symbols such as x and y to stand for unknown quantities. In simple algebra, the symbols stand for numbers and the values of the unknown quantities can be found. Algebra is very important because it is a way of putting an idea or an observation down on paper, so that an unknown factor can be determined. Algebra is essential in almost all branches of mathematics and the physical sciences, such as physics and chemistry. But algebra can also be used in social sciences such as economics and psychology. The symbols may be used to represent people and the way they act, and may predict how people will behave in a general way.

Calculus is a form of algebra that deals with changing quantities. It is used in engineering and physical science. When a space-ship takes off, for example, it builds up speed very quickly. Calculus can be used to find out how the speed increases, and the speed of the ship at any instant can be calculated.

Geometry is concerned with lines, angles, figures and solids. Euclidean geometry is the kind taught in school, and it is very important to architects, engineers and navigators. Plane geometry deals with plane figures such as squares and circles and solid geometry deals with three-dimensional figures such as cubes and spheres. The branch of geometry that is concerned with angles and measurements is called *trigonometry*. Navigators and surveyors use trigonometry to calculate courses and distances.

Co-ordinate geometry is a combination of algebra and geometry. The symbols of algebra are used to represent a line or a figure or a solid. Engineers and architects find this branch of mathematics useful in designing bridges and buildings.

Set theory is a kind of algebra. It uses symbols to solve general problems in mathematics and in logic or reasoning. A study of set theory gives you a better understanding of the basis of mathematics, and it is part of new mathematics teaching.

Statistics is concerned with counting. Statisticians find out numerical facts about many people or situations, and analyse these facts to find out exactly what happens in a given situation. They can then express the chance of a certain situation occurring. This kind of mathematical work is important in government and insurance.

Mathematics began as soon as man began to count on his fingers. The people of ancient Babylon, Egypt and China evolved ways of using mathematics about 5,000 years ago, as is evident from old manuscripts and from the building of the pyramids. But they used mathematics to solve practical problems. The ancient Greeks developed mathematics by thinking about it. Euclid devised many theories of geometry, Pythagoras explained the nature of numbers, and Archimedes invented calculating methods that foreshadowed calculus. After the Greeks, the Romans used mathematics for great feats of construction, but did not develop the science. After the fall of Rome, the development of mathematics passed to the Arab world, and in about A.D. 800 algebra was devised by the Arabs. European

scholars began to study Arab mathematics after about 1200, and with the Renaissance of learning in Europe that took place after 1400, mathematics began to develop widely. There has been steady progress ever since.

Matter, states of Everything in the universe that takes up space is matter in one form or another. Matter is composed of basic units, called *molecules* (which themselves are made of smaller units, called *atoms*). All matter exists in one of three physical states: *solid, liquid,* or *gaseous.*

Water is a substance that is familiar to us in all three states. As a liquid, it flows from our taps; as a solid, it is the ice that cools our drinks; and as a gas, it is the steam that rises from a boiling kettle. (The cloud of water vapour that we can *see* rising from the kettle is not steam. Steam is between the surface of the water and the vapour and is invisible.)

These physical states depend upon the amount of movement or *kinetic energy* in the molecules of the substance, and this, in turn, depends on heat. Solids are the coldest form of a matter. They occur below its *freezing* temperature. Solids are hard, have a definite shape and do not compress easily. Their molecules are often arranged into a *symmetrical* (having a regular form), three-dimensional pattern, known as a *crystal.* Clay and other *amorphous* (shapeless) solids have a less regular structure.

Liquids occur between the freezing and boiling temperature of a matter. They have a definite *volume* (space they take up), but no definite shape. This means that they take the form of their container. Liquids flow because their molecules are free to move past one another. But some liquids, such as glass, are so *viscous* (slow moving) that they appear to be solids.

Gases exist at temperatures above the boiling point. Their molecules move freely, so they fill every part of a container, regardless of size. Unlike liquids and solids, gases can be easily compressed.

Some substances are familiar to us in only one state (iron, for example, is usually solid). But this is only because their boiling or freezing points are not within the normal temperature range. If iron is heated sufficiently it will melt. That is how it is *cast* (poured molten into moulds). And if heated still further it can be *vaporized* (turned into a gas).

Matterhorn is one of the great mountains of Europe. It is located in the Pennine Alps, on the border between Italy and Switzerland. The Swiss mountain village of Zermatt is nearby. The Matterhorn rises to a peak 14,780 feet above sea level. Snow and ice cover its slopes all the year.

Numerous attempts to reach the summit failed before it was first successfully scaled in 1865 by a British expedition led by Edward Whymper. Four climbers were lost on the way down.

Mauritania is a republic on the Atlantic coast of Africa. Its capital, Nouakchott, is a port. Mauritania has an area of 419,230 square miles. It consists largely of deserts. Its 1,200,000 people are almost all Muslims. About one-fifth are Negroes who live in the south near the Senegal River. There the land is fertile. The rest of the people are Moors of mixed Arab and Berber descent. They herd livestock. Some minerals, especially iron and copper, are found in desert regions. Large scale mining of these minerals began in the 1960's and they are now a major export. Mauritania was a French colony until 1960.

Location map of Mauritania.

The ruins of the Mayan Temple of the Sun at Palenque.

Mauritius is a small Commonwealth country in the Indian Ocean. From 1810 until receiving its independence in 1968, it was a British crown colony. Before that, it was held first by the French and then by the Dutch.

Mauritius has 823,000 people and is growing rapidly. But for an island that is only 38 miles long by 29 miles wide at its widest points, it is becoming overpopulated. Most inhabitants are descended from Indian plantation workers recruited in the 19th century to replace freed slaves. Many others are *Creoles* of mixed European and African or Indian descent.

Location map of Mauritius.

Mauritius has several volcanic mountains. The growing and processing of sugar-cane is the principal activity of the people. Some tea and tobacco are also cultivated. Exports and imports of food pass through Port Louis, the capital.

Maya Men first entered the American continent during the last ice age, when Asia was joined to Alaska. They lived by hunting and fishing. The American Indians are physical cousins of the Mongols and Chinese.

The area in which civilization first developed was Central America. American corn, gourds and sweet potatoes were cultivated and the dog and the turkey tamed. About the beginning of the Christian era, the Maya began to build cities in stone. Their cities contained a temple, a palace, pyramids, a monastery, observatories, and platforms for dancing. There was a ball court, in which a religious game, like

hand-ball, was played. The elbow, fist or hip were used, not the open hand. There were suburbs in which each dwelling was an independent farm.

The Maya relied on 'slash and burn' farming. Instead of manuring the ground and changing the crops, the forest trees were cut and burnt and the same crop was sown year after year. When the soil was exhausted people had to move on to a fresh part of the forest. So Mayan cities had to keep moving. After A.D. 850 the whole civilization began to decay.

Mayans were organized in city-states, rather like ancient Greece. There were a hereditary aristocracy, merchants and a priesthood. Mayan life was controlled by religion; beautiful temples were at the centre of every city. They worshipped a supreme God, called Hunab. Today many of the Mayan cities are hidden in the jungle. (See Aztecs; Incas.)

Mayfly This is a graceful insect with two or three long tails trailing behind it and usually four gauzy wings. Mayflies are found near water. There are about 1,500 species of mayflies.

The mayfly lays its eggs in rivers and streams Nymphs hatch from the eggs and live underwater, breathing by means of gills and feeding on water plants. After several months, the nymph leaves the water and becomes a winged *subimago*, a form that resembles the adult mayfly except that it is dull in colour. After a few hours, the subimago sheds its skin and becomes a shiny adult. The adult does not feed, and it dies after a few hours or days, during which time new eggs must be laid. Even in this short time, the insect may fall prey to a fish when it approaches the water. Fisherman use imitation mayflies made from silk and feathers to catch fish.

Mecca (pop. 200,000) is a city of Saudi Arabia and a centre of pilgrimage for the entire Muslim world (see Islam). It is the Holy City of Muslims and birthplace of Mohammed. It lies in a narrow valley 45 miles east of its port of Jedda. Once an important centre of trade, the city is now mainly preoccupied with the business of catering for the many pilgrims.

The Ka'aba, the sacred shrine of the Islamic religion, is situated in the courtyard of the Great Mosque al-Haram. The black stone 'given by Gabriel to Abraham' is set in the wall of the Ka'aba and kissed by those making pilgrimage.

Medals and Decorations are awards given to honour soldiers or civilians for distinguished service or achievement.

A Chelsea pensioner with his medal ribbons pinned to his chest. An old soldier's experience can be summarized by the campaign ribbons he wears.

Victoria Cross
(Britain)

Medal of Honor
(U.S.A.)

Air Medal
(U.S.A.)

Distinguished
Service Medal
(U.S.A.)

Militaire
Willensorde
(Netherlands)

Iron Cross
(Germany)

Order of Victory
(U.S.S.R.)

Order of
Leopold I
(Belgium)

Legion of Merit
(U.S.A.)

Treasury Life-saving
Medal (U.S.A.)

George Medal
(Britain)

Purple Heart
(U.S.A.)

Medal of Freedom
(U.S.A.)

Distinguished Service
Order (Britain)

Distinguished Flying
Cross (U.S.A.)

Distinguished Service
Cross (U.S.A.)

Modern military service medals are usually round, while most decorations take the form of a star or cross.

History shows that the giving of honours dates back to ancient times. The Egyptian pharaohs honoured their subjects by awarding them golden flies. In imperial China, people were favoured with peacock feathers, hat badges, and special robes. Early European kings are often referred to in literature as 'ring-givers', because they presented their generals with rings as tokens of appreciation.

Awards were generally received by those closest to the king, and since many rulers personally led their soldiers into battle, they tended to give awards for bravery and for long and faithful service. When a great victory won on some foreign shore was reported to the king, he usually awarded a medal to the victorious general. Gradually, orders of honours developed in Europe. Some consisted of medals only, while others carried titles and rewards of money or land. All medals and orders were awarded at the king's pleasure. They were personal honours, for which there were no set qualifications.

The first specific military awards were established during the late 1700's. In 1782, George Washington created the *Badge for Military Merit* (now called the *Purple Heart*). Napoleon I established the *Légion d'Honneur*, still the highest French military decoration, in 1802. Britain's *Victoria Cross*, awarded for 'conspicuous bravery in action', was established in 1856. Today, nearly all countries award medals for distinguished service. These awards are different from commemorative medals, which are given to every soldier who fought in a particular battle or campaign.

The highest British award for bravery is the Victoria Cross which is awarded to citizens of the Commonwealth for showing exceptional courage in battle. The most recent V.C. was won by Australian Warrant Officer K. Payne in 1969 for bravery in the Vietnam war. Holders of the V.C. receive £100 per year for life from the British government. The medal bears the simple words 'For valour'.

Civilian honours are comparatively recent, and may be awarded for bravery, public service, or excellence in scientific, artistic, or professional work.

Medici is the name of a famous Florentine family that flourished from the 1400's to the 1700's. Its members were businessmen, rulers and patrons of the arts.

The founder, *Giovanni* (1360-1429), made a fortune in banking and commerce, and held public office in Florence. One of his sons, *Cosimo the Elder* (1389-1464), became absolute ruler of Florence and founded the family's political power. He was also a generous patron of the arts and scholarship.

Lorenzo the Magnificent (1449-1492), grandson of Cosimo, was an astute politician and a notable poet. He survived a plot against him headed by the pope, continued his grandfather's policy of patronage and filled Florence with treasures. His son, *Giovanni* (1475-1521), became pope as Leo X, in 1513.

An oil painting of Piero de Medici (1414-1469). He was the father of Lorenzo the Magnificent.

Medicine There are two meanings to the word medicine. The first is the science of healing, which involves both prevention and cure of disease. Hippocrates, born in 460 B.C., who is said to have been the father of this science, helped to define the aims of medicine in his Hippocratic Oath: 'I will use treatment to help the sick according to my ability and judgement, but never with a view to injury and wrong-doing.' Medical students once had to repeat the Hippocratic Oath on becoming doctors, but they do not have to do so today. They are still expected to abide by it, however.

The doctor is also expected to share whatever knowledge he may discover, to keep secret all information confided to him, and above all things to seek to benefit his patients.

Heavy demands are placed upon doctors, surgeons and medical research workers, and a great part of their reward is the feeling that they are helping other people, in the relief and prevention of suffering.

Medical science is concerned with treating both physical and mental illnesses, with the control of epidemics and the maintaining of public health.

It has taken many centuries for the practice of medicine to become truly scientific. Before Hippocrates' day, doctors concerned themselves largely with magic remedies. Believing that disease was caused by demons, primitive men cut holes in a patient's skull to let the demons escape. Prayers and charms are resorted to in some societies even today. Hippocrates introduced careful observation and common sense into medical treatment, but much of his teaching was ignored and forgotten for over a thousand years.

One of the great handicaps medieval physicians laboured under was the reliance on authority. Galen, a great Roman physician, dominated medicine for centuries. All of his teachings were held to be correct—even those that

Above top: For many centuries hospitals were run by Christian monks and nuns. Above left: William Harvey discovered the circulation of the blood. Above right: Sir Ronald Ross discovered the cause of malaria. Right: Sir Frederick Gowland Hopkins pioneered work on vitamins. Below: Dr Jonas Salk discovered the poliomyelitis vaccine.

could be seen to be wrong. Another difficulty was presented by the use of reason in place of observation. Thus a doctor would decide that a certain cure ought to succeed because it seemed reasonable, instead of looking to see whether or not the patient was really being helped. Not until the seventeenth century did most doctors begin to look and experiment and judge for themselves how best to treat an illness. And medicine has advanced faster in the last 300 years than it had in the previous 2,000.

The second meaning of the word medicine refers to all tablets, powders and liquids which are given internally in treating a sick person. Early medicines were nearly all made from plants, usually from the roots and the leaves. Modern medicines draw on some old remedies, and also include many complex substances.

Mediterranean Sea This is a large, almost landlocked body of water which is enclosed by three continents—Africa, Asia and Europe. Its outlet to the Atlantic Ocean is the Strait of Gibraltar, which is only 8 miles wide at its narrowest point.

The Mediterranean covers an area of 1,145,000 square miles. It includes the Adriatic, Aegean, Ionian and Tyrrhenian seas. An important waterway consisting of the Dardanelles Strait, the Sea of Marmara and the Bosporus Strait connects the Mediterranean to the Black Sea. (See Black Sea; Bosporus.)

Near the Strait of Gibraltar, the Mediterranean is only about 1,000 feet deep. But its deepest point, in the Ionian Sea, is more than 16,000 feet deep.

There are many islands in the Mediterranean. The largest islands are Sicily and Sardinia, which belong to Italy, Corsica, which belongs to France, Crete, which belongs to Greece, and Cyprus, which is an independent nation.

Smaller islands include the Balearic Islands off Spain, the Cyclades, Dodecanese, and Sporades in the Aegean Sea, the Ionian Islands, Malta and Rhodes. A volcano rises from Stromboli, an island in the Tyrrhenian Sea. It is one of the few constantly active volcanoes in Europe.

Many rivers flow into the Mediterranean. They include the Nile in Egypt, the Po in Italy, the Rhône in France and the Ebro in Spain. In spite of this, the high level of evaporation means that the waters of the Mediterranean are far more *saline* or salty than the water in the Atlantic. Another feature of the Mediterranean is that tides are small. The difference between high and low tide is only about a foot.

The Mediterranean was an important sea in ancient times. It then represented the centre of the known world to the people of the great civilizations that arose around its shores. The name 'Mediterranean' comes from Latin words meaning the 'middle of the Earth'.

The eastern Mediterranean was one of the homes of the science of navigation. Early sailors, who would have been terrified by vast expanses of open water, such as the Atlantic, could sail the Mediterranean without fear. They were seldom long out of sight of either the mainland or one of the many islands. Early sailors thought that the Strait of Gibraltar was the end of the world and that, if they sailed beyond, they would fall off the edge. But bold Phoenician seamen disproved this idea when they sailed into the Atlantic.

The Ancient Greeks and Romans later used the Mediterranean sea routes explored by the Phoenicians. The Romans controlled the Mediterranean for more than 400 years. They often called it *Mare Nostrum*, which means 'our sea'. The Mediterranean remained of great importance when Europe began to trade with Asia. But it lost its importance after 1499, when the Portuguese explorer Vasco da Gama completed his great journey from Europe to India and back around the southern tip of Africa, establishing a new trade route to Asia.

The Mediterranean increased in importance after 1869, when the Suez Canal

Above: The lands surrounding the Mediterranean have seen the flowering of a number of great civilizations, including those of Egypt, Crete, Greece and Rome. Many relics of these, such as these Greek *amphorae* (wine jars), have been discovered on the sea-bed.

Top right: The dry, sunny Mediterranean climate supports a sparse, often prickly, vegetation (called *maquis* in southern France). The climate also makes the Mediterranean countries very popular with tourists.

Right: Location map of the Mediterranean.

Below: *Mediterranean* means 'centre of the earth' in Latin and to the ancients it was just that. Although this is no longer true, many of the ancient ports on the Mediterranean's shores are still thriving centres of commerce.

was opened. This canal was cut across Egypt to the Red Sea. It greatly shortened the distance from Europe to Asia by boat.

In the 1940's and 1950's the fine summer weather of the Mediterranean began to attract an increasing number of holiday-makers.

Mekong is a great river that flows a distance of 2,625 miles through south-east Asia. It rises in the mountains of Tibet, then flows southward through China, Laos, Cambodia and South Vietnam, before emptying into the South China Sea. It forms part of the Laos-Burma and Laos-Thailand borders. Near its mouth, the river divides to form a broad delta. In this region, large quantities of rice are cultivated.

The river has seasonal high and low periods, but rarely floods, because the connecting Tonle Sap River acts as a reservoir for excess water. The Mekong is blocked by sand and rapids in its upper course, but is navigable for the lower 350 miles. Phnom Penh, Cambodia's capital, is a major port. In the 1960's the United Nations began a scheme to develop the Mekong.

Melanesia. This is a group of islands in the south Pacific lying to the north and north-east of Australia. By far the largest island in the group is New Guinea. Among the others are Fiji, New Caledonia, the Solomons, New Hebrides and Loyalty islands. The islands are generally covered with dense forests. Mountains on some reach 16,000 feet. The weather is hot, with heavy rains and tropical storms. Politically, Australia, Britain, France and Indonesia administer the islands.

The Pacific islands were first explored by Europeans in the 1600's. In the late 1700's, Captain James Cook visited New Guinea and New Caledonia. Trading and refuelling stations were established by explorers. Later, schools, missions and

Melanesian schoolgirls, colourfully dressed to perform their traditional dances.

Melbourne race course is one of the fashionable meeting places of the city's society. Melbourne is regarded as the cultural capital of Australia. The art galley, the first part of a complete cultural centre, was opened in 1968.

medical facilities were set up. Contact with Europeans altered native ways of life greatly. Among other things, it brought new diseases that killed many islanders. Today, Fiji and New Caledonia have the largest European populations.

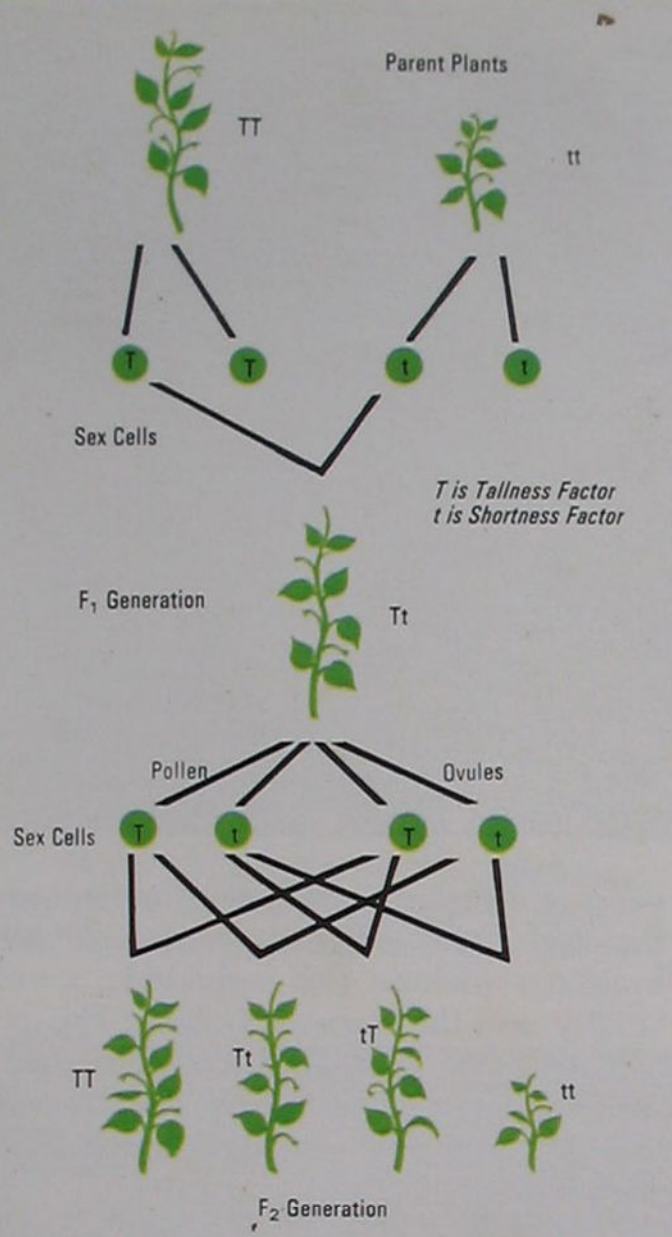
The Melanesians are a dark-skinned people, of stocky build with very curly hair. They speak a variety of native tongues and some pidgin English. They spend most of their time obtaining food. They grow taro and yams in small gardens as a staple food. They also eat coconuts, bananas, breadfruit and sago. In coastal areas, people fish with darts and spears.

Melanesian life centres on the village, which is made up of related families. In the past, warfare was common between groups and the victors sometimes practised head-hunting and cannibalism.

Melbourne (pop. 2,372,000) is the capital of the state of Victoria, and second largest city in Australia. Its seaport at the mouth of the Yarra River is one of the main ports of the southern hemisphere. The city was founded in 1837 and became state capital in 1851. Industry has prospered in recent years and the city is fast developing into a financial and cultural centre. Public buildings include two cathedrals, a university, and the National Gallery. The city is noted for its wide thoroughfares and pleasant parks and gardens. The open-air concerts in the Sidney Myer Music Bowl are famous.

Memory is involved in almost every part of our lives. It is obviously involved when we remember a friend's address or a multiplication table. But it does not necessarily involve thought. We use memory when we ride a bicycle or do some other action we have learnt. Even animals, which do not experience thought, use memory—when, for example, a dog recognizes its owner. In fact, memory is involved whenever past experiences influence actions.

Many factors affect how well we remember something. For instance, repeating something drums it into our memory. That is why we have to say multiplication tables over and over again. It is easier to remember something interesting than something boring. Remembering is also



Mendel discovered that when tall pea plants are crossed with short pea plants the first (F_1) generation is all tall, but the next (F_2) generation is of two types – tall and short in the ratio of 3:1. He realized that tallness is produced by some 'factor' in the cells which is *dominant* to the factor for shortness, and that only one of two opposing characteristics can be passed on by a parent.

Gregor Mendel (right) was a monk who experimented with plants in his monastery garden. From his observations he discovered the laws that govern heredity, or the inheritance of basic characteristics. Like many researchers, he was ahead of his time, and his important discoveries were ignored until some time after his death.

easier if we understand something rather than simply learn it 'parrot-fashion'.

How memories are stored in the brain is unknown, but scientists believe that remembering is a two-stage process. Many memories – a telephone number we have just looked up, for instance – never get any farther than some kind of temporary memory store. Important things are then transferred after a few seconds to our permanent memory.

Mendel, Gregor Johann (1822-1884), discovered the principles of *heredity*. This is the passing on of physical and mental characteristics from one generation of living things to the next.

Mendel was born in Austria and became both a botanist and a monk. He grew up on a farm and it was there he first became interested in plants. In 1843 he decided to become a monk, and entered an Augustinian monastery, where he spent the rest of his life. He devoted much of his time to the study of plant heredity.

Mendel began by growing pea plants and observing their characteristics. He noticed when planting seeds of red flowered plants that only plants with red flowers were produced. Next he crossed white flowered plants with red ones by transferring the pollen of one to the other. The result of this was a new generation of plants all with red flowers. Mendel then crossed these plants with each other, and three-quarters of the new plants were red and one-quarter were white.

Mendel obtained similar results when he experimented with tall and short pea plants. By crossing pure tall plants with pure short plants he obtained only tall plants, but when breeding from this new generation he obtained three tall plants for every short one. Mendel concluded that each feature, such as height, is controlled by a pair of 'factors' (we now call them *genes*) and that only one of a pair can be passed on by each parent. He also discovered that in each pair of factors one is dominant over the other.